

were all negative. The most serious potential hazard existed in a cone with an oxygen content of 5.5% and a carbon dioxide content of 11.7%. The source of the carbon dioxide has not been established but may be produced by bacterial or chemical action on the whiting used to keep the cable from sticking. (19)

3. Rapid drying primers. A study is in progress to determine the feasibility of the use of rapid drying primers for steel plate. The search is particularly slanted toward obtaining a paint which may be welded upon without producing a faulty weld. At present, zinc chromate primer must be removed in the way of welding because of porosity of the weld. The Industrial Hygiene Division investigated the health aspects of two of these paints, a lacquer primer and an acrylic ester base paint. Application of rapid drying paints always poses an industrial health problem because of the evaporation of solvents. When applied outdoors in the steel yard, sufficient dilution of vapors should occur so that exposure to hazardous concentrations would be limited to those engaged in the actual application. Application of lacquers or acrylic paints elsewhere would require precautions similar to those now used for Saran and epoxy coatings. Tests were made for potential health hazards created by the decomposition of the dried paint film by welding and burning. Tests were made for carbon monoxide, oxides of nitrogen, phosgene, acidic or alkaline gases, and aldehydes were found under laboratory conditions. To date, tests indicate that the normal precautions used in welding or burning, i.e., the proper use of exhaust ventilation or respiratory protection, should prevent exposure. However, should welding or burning take place on a bulkhead or deck coated with material on the opposite side, decomposition of the paint could occur in adjoining spaces with harmful results. (4)

4. Inhalation. The first application of Devran Coating by this shipyard was accomplished without incident. The coating was applied not (about 160° F.) by spray methods to the interior of submarine ballast tanks. Complete skin protection and the use of air line respirators were required for painters applying the coating. Gloves and charcoal-type respirators were used by painters mixing or carrying the resin. Tests for organic amines and for butyl cellosolve in the exhaust air from the ventilating system and in the area immediately over the mixing tank were well within the accepted permissible limits. (19)

5. Employee inhaled chlorine while attempting to clear the atmospheric vent tube to a chlorinator by blowing into the tube with his mouth. When the obstruction was blown clear the chlorine fed back into the line and the employee inhaled enough gas to cause respiratory discomfort and throat irritation. An investigation of work methods indicated the present practice of clearing plugged chlorine lines by blowing into them should be discontinued; the use of an aspirator was recommended for this purpose. It was further recommended that employees working on chlorine charged lines or equipment wear the gas mask provided. (9)

6. Trichlorethylene. Employees on a 2nd. deck of a building complained that a strong solvent odor was present in the shop and a number of them felt dizzy and nauseated. Investigation failed to reveal any use of solvents in the shop but there was an unmistakable odor of trichlorethylene the source of which was finally traced to a shop on the 1st. deck. There a vapor degreaser was found to be improperly used. The rinse nozzle was connected to a source of compressed air and clouds of trichlorethylene vapors were being blown out of the machine. The tremendous amounts of contaminant thus created permeated the work area and channeled through the ceiling to the floor above. The steam pressure was set too high, so that the solvent was overheated. The vapor cut-off thermostat was inoperative. The operator wore a chemical cartridge respirator which apparently was inadequate because he complained of "feeling drunk". The other employees nearby were also affected. The machine was ordered taken out of use until such time as a liquid pressure pump would be installed instead of compressed air for the rinse operation and until other repairs were made to ensure that the vapors are controlled. This was accomplished within a few days. Follow-up tests were made and the vapor concentrations were found to be consistently below 50 parts per million indicating that normal conditions were obtained. (5)

7. Fumes from Burnout Tests. An investigation was made in the Power Section of the Material Laboratory, Bldg. #296, in which is located a high power test station which can apply as high as 100,000 amperes and 500 volts to circuit breakers and other power equipment undergoing test. These tests are made intermittently and personnel must be in the control room at time of test. Any burnouts that occur dissipate fumes and gases into the open high ceiling area above the test cell. In some instances an air line hose may be used to blow out fumes that still linger in the equipment tested. Under conditions of operation observed, there is no hazard to personnel from inhalation of fumes or gases and installation of exhaust blowers is not considered necessary. (10)

8. Industrial hygiene practices were formulated for the fabrication of the lead shielding for the nuclear waste tanks aboard the USS FULTON (AS-11). These included ventilation, personal protective measures when necessary and good housekeeping. (11)

9. Tricresyl Phosphate. An evaluation was made of the amount of tricresyl phosphate discharged by a vacuum pump, evacuating the insulating void around liquid oxygen containers. In order to drive-off moisture from the void, gaseous nitrogen is fed to the tricresyl phosphate which is used as pump oil. This results in a mist analyzing between 51 and 72 milligrams per cubic meter of tricresyl phosphate at 1 foot downstream from the point of discharge. Recommendations for extension of the exhaust vent and/or provision of a mist eliminator have been (6)

made. A revaluation after installation of an oil filter cartridge element resulted in a concentration of 1.1 milligram per cubic meter. An additional recommendation calls for a revision of the procedure so as to eliminate any misting of tricresyl phosphate. (6)

10. Inhalation. The use of 'Dion-Iso' polyester resin was under study for possible use in the coating of exposed metal framing in plastic fair-waters. The use of this material introduces a serious potential hazard because of the presence of dimethylaniline/<sup>in the promoter</sup> is highly toxic with a threshold limit value of 5 ppm and can be readily absorbed through the intact skin. Skin, eyes, & clothing should be thoroughly protected & water flushed when contaminated. Clothing should be removed and washed before reuse. Either adequate ventilation or respiratory protection should be provided. (19)

11. Three men reported to the Dispensary for personal decontamination after having been accidentally sprayed with Phosphate Ester Fluids. A visit to the work site confirmed the belief that the exposure experienced during this accident was negligible; however, it also indicated the need for better process controls. It was evident that in spite of previous instructions, employees were not following the exposure control measures recommended. They were re-instructed in these measures which are as follows:

- a. In general, avoid skin contact and vapor, mist or aerosol inhalation.
- b. Wear protective gloves, face shields, and other protective clothing, when indicated.
- c. Use catch pans, containing a small amount of water whenever possible. Empty these pans frequently.
- d. Clean up all spills promptly with soap and water. Use a covered container for disposal of rags.
- e. Minor spills on the person should be cleaned immediately with soap and water. Employees having the material sprayed in the eyes, mouth, or over large portions of the body should report to the Dispensary for decontamination.
- f. Machine parts should be cleaned thoroughly before any maintenance involving burning is attempted, and exhaust ventilation provided for such operations. (2)

12. Approximately 200 pounds of pentachlorophenol, a wood preservative and insecticide, was sprayed in the basement of the Rope- (8)

walk Building by outside contractors. Several days later Shipyard employees were found repairing sections of pipe in this area without benefit of respiratory protection. Wearing of chemical cartridge respirators was immediately required. Samples taken to determine the atmospheric concentrations of pentachlorophenol showed amounts to 0.036 milligrams per cubic meter. Although this is less than the maximum allowable concentration, even a short exposure caused irritation of eyes and mild headache, and thus reduced production efficiency. The area was posted with a "Warning" sign. (8)

13. The recommendation that methyl chloroform be used as the solvent to wipe hydraulic fluid stains from the walls of the missile room aboard a guided missile cruiser was adopted and proved successful. This cleaning procedure was preliminary to applying an epoxy resin to the same surfaces. For both the solvent cleaning and paint spraying operations, supply ventilation and respiratory equipment provided adequate protection against the health hazards involved. (8)

14. Inorganic Materials. Dust concentrations were measured during application of magnesia and fiber glass lagging. The materials are preformed to fit over pipe fixtures. During application in a confined steam tunnel, magnesia dust was always in excess of 50 million particles per cubic foot while fiber glass did not exceed five million. Respiratory protection is mandatory for the magnesia. The fiber glass is reported to cause itching, therefore skin covering has been suggested (long sleeves, high collars, etc.). (6)

15. De-Oxalum. As previously reported, De-oxalum is a proprietary product used to clean aluminum prior to welding. The use of this material originated with the Philadelphia Naval Shipyard. Further investigation was requested by the Awards Committee at this activity. Tests indicate that De-oxalum may contain secondary butanol in addition to the butyl cellosolve and acidic component. It will decompose with heat, forming considerable sulfur dioxide. There have been some complaints of a tight feeling in the chest by personnel using this material. This tends to confirm the presence of the alcohol since such complaints are common when using the higher alcohols. Therefore, it was recommended that, in addition to the eye protection specified, the material should not be allowed to contact the skin, and it should be used in a well-ventilated area or with exhaust ventilation. Organic vapor cartridge respirators may be necessary. (4)

16. Paint vapors. Investigation was made of a Beneficial Suggestion which advocated that hatches of freshly-painted compartment be propped open about 3/4 of an inch to allow air circulation. At present, freshly painted compartments are closed off and sealed. (4)

Oxygen in the compartment is depleted by the oxidation of the paint, carbon monoxide may be formed, and various contaminants are released to the air in the form of solvent vapors, oxidation products, etc. When entering these compartments there is usually considerable eye and upper respiratory tract irritation. Directives require that tests must be made by the Gas Free Engineer or his representative, and ventilation utilized as necessary before entry into such a compartment can be effected. The amount of ventilation afforded by a 3/4 inch opening produced by propping one end of a hatch cover open with a wood block would be negligible. Accordingly, the adoption of the suggestion was not recommended. (4)

17. Following receipt of reports of the presence of benzol in JP-4, samples were taken from 4 aircraft arriving for overhaul. There was no benzol found in any fraction. (15)

18. A detailed industrial hygiene survey of Shop 51 was made. Some of the operations have varying degrees of health hazards associated with them. Precautionary measures were recommended and adopted on the following operations and areas:

- a. Control of fumes and dust and handling chemicals in Battery Repair Shop
- b. Removal of radioactive markers
- c. Handling electric plastic sealing & insulating compounds
- d. Handling toxic chemicals in the Plating Section
- e. Control of dust and solvent vapors in Motion Picture Repair Section
- f. Control of fumes in Silver Soldering both, ICE Section
- g. Installation of exhaust ventilation at buffing and grinding wheels, ICE Section
- h. Operation of Detrex Degreaser, ICE Section
- i. Disposal of radioactive luminous paint, Engraving Section
- j. Noise sound pressure levels and frequency analyses
- k. Labeling of hazardous chemicals and materials (10)

19. Several employees were having difficulty with fumes while burning out boiler tubes in a confined area aboard ship. Two employees had been overcome. Carbon monoxide was suspected and on sampling, high concentrations of carbon monoxide were found. A discussion was held at a shop supervisors meeting on the above hazard. They were instructed in the effects of carbon monoxide and reminded of the need of adequate ventilation during burning operations. (3)

20. Carbon Monoxide. An exhaust fume problem in a large aircraft assembly building was partially resolved when two large capacity diesel power units were installed in the outside of the building to supply electric power to two production lines. Prior to this, as many as 4 gasoline-driven auxiliary power units had to be used at each aircraft because of insufficient electrical capacity of the building. Under those conditions, concentrations of carbon monoxide approaching or exceeding the MAC were frequently encountered. (6)

21. An investigation was made to determine the carbon dioxide hazard from a new 35 cubic foot dry ice storage tank located in a large industrial work room. The tank was open at the top with a heavy insulated blanket covering the dry ice. Although the carbon dioxide concentration within the tank was over 25% with the blanket removed, it was never above 0.5% at the breathing level 1 foot above the tank and general room ventilation was sufficient to maintain the carbon dioxide concentration of the room air within permissible limits. It was recommended that long handled tongs be provided and used for the removal of the blocks of dry ice, thus eliminating the possibility of anyone reaching or climbing into the tank. (9)

22. Employees using teflon coated electronic wire questioned the plastic as a source of throat irritation resulting from solder operations. Due to the size of wire, type of operation, and materials used no hazard could be found in the operation. (15)

23. While welding on its exterior hull no fume generation was noted to occur within a saran-coated gasoline tank aboard an AO. Heat from the welding of outside rivet-heads did not appreciably penetrate through the two 3/4 inch plates to cause decomposition of the saran resin. (8)

24. Carbon dioxide shielded welding. Further tests were made of inert gas shielded electrode welding utilizing carbon dioxide gas as the shield. Tests were made while repairing a defective casting under a portable canopy in a dry dock. No positive ventilation was used. Natural ventilation was good. The Draeger test for oxides of nitrogen indicated a trace. Carbon monoxide was negative, except over the head (4)

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of the welder in the smoke plume (100 parts per million). The welder wore an air-supplied sock hood. His protection was considered adequate. In this connection investigation was made of a Beneficial Suggestion advocating a long linear (about 2 inches by 30 inches) exhaust hood for welding with carbon dioxide shielded arcs. It was pointed out that this would be effective only for a linear weld and in no case would it prevent exposure to ozone which is formed, not only at the arc; but several feet distant from the arc by the action of the intense ultra violet radiation. The principle of low velocity-high volume air movement as suggested was correct. It was recommended that a square or rectangular hood be utilized. (4)

25. Welding within a lower deck compartment aboard a destroyer was stopped when a heavy concentration of xylene vapors was found constituting a health and fire hazard. Temporary exhaust ventilation which had been installed during the spray painting of an adjacent ammunition storage compartment had been removed before sufficient drying and to exhaust solvent vapors. (8)

26. Investigation of a number of eye "flash" burns to welders working on the inert-gas metal arc process showed that welders were not wearing protective sideshields on their safety glasses and as a result did not have adequate protection against the scattered ultra-violet radiation given off by other arcs in the work area. The need for this sideshield protection is emphasized by the increased number of "flashes" reported to the Dispensary, particularly in confined areas where welders are working in close proximity to each other. As a corrective measure it has been recommended that welders have their safety glasses, worn under their hoods, equipped with sideshields. This applies to both prescription and non-prescription safety glasses. (9)

27. Shop 11-26 recently began an extensive aluminum welding project using aluminum alloy No. 55-56 containing 5% magnesium. Sixty-one S, (61S), aluminum alloy containing about 1% magnesium was formerly used. The employees noted: (a) an increase in fumes, both by odor and vision; (b) a different light glow from the arc; (c) sparks on cleaning a hot welded area with a wire brush; (d) erythema and burning of the skin. The major health hazards associated with this welding process are ozone gas and ultraviolet radiation. Ozone gas causes nose and throat irritation and lung congestion. It can be extremely hazardous in confined areas. Ultraviolet radiation causes skin burns & visible light intensity is also increased in this welding process.

The same health hazards exist with each of the above alloys. On a comparative study, using an Ultraviolet Photometer, the ozone (3)

concentration appeared to be increased with the 55-56 alloy. The increased light intensity and sparks are due to the increased magnesium content. The following recommendations were made: (a) the instructions given in BuShips Instruction 6450.4, of 10 September 1958 should be followed; (b) cover all exposed skin surface of the welder; (c) personnel with exposed body surfaces should not remain in the vicinity of the direct light rays; (d) use a No. 12 glass in the face shield; (e) welding should be performed only with adequate ventilation; and (f) ventilation should be supplemented with air supply respirators if necessary. (3)

28. Wood Preservative, Pentachlorophenol - Painters in the Material Laboratory will use this paint on the roof of the building. The cognizant supervision was advised that skin contact with, or inhalation or vapors from, this preservative should be avoided by the use of suitable protective clothing and equipment. (10)

### B. Health Hazards Due to Contact with Skin

1. Experiments were recently conducted in the Shipyard in the application of 100% reactive epoxy coatings. The unusual features of the coatings are the absence of solvents and the use of diethylamine triamine adduct for the hardener. The adduct is made by reacting the diethylamine triamine with some of the resin which results in a faster curing rate. This should help to lower the vapor concentrations and reportedly results in a reduced skin-irritant potential. (19)

2. Two welders have developed rather severe dermatosis of both hands with what appears to be sensitization to chrome leather welding gloves. Standard stock unlined welding gloves have been used for a long period of time without difficulty. At present both employees are wearing cotton work gloves under asbestos mittens with good results. As soon as these skin conditions clear the use of lined welding gloves will be given a trial. (9)

3. Five employees using "Clarco" disinfectant for cleaning floors were affected by skin irritation, one severe enough to require treatment by a physician. The disinfectant is reported to contain isopropanol and chlorophenyl-phenol soap. Patch tests with the material indicate it to be a primary irritant in the recommended dilution, possible because of unreacted phenol. The use of disinfectant has been discontinued. (19)

4. A few cases of dermatitis have occurred during the quarter, some of which were traceable to possible cross-infection and others to personnel allergies or nervous conditions. The cross-infection occurred in a group of assemblers working on a single aircraft and forced into very close quarters. One of the crew had a previous history of skin irritations (4)

or infections and observed poor standards of personal hygiene. It was significant that all other members of his crew excepting a part-time worker acquired similar conditions, two of them being severe enough to be treated at the Dispensary. Another case of allergic origin resulted in persistent skin irritation whenever the patient approached her regular working environment. A study of the materials handled failed to reveal any primary irritant. Employee was given leave for alleviation of her condition and the medical officer will see to reassigning her to a different type of environment. (6)

5. Three men reported to the Dispensary complaining of a burning sensation on their hands experienced as a result of contacting a fluid while working on an oxygen generator being prepared for shipboard installation. It was immediately determined that this fluid was a concentrated solution of potassium hydroxide leaking from a line and there was no warning plaque on the machine. It was further determined that this machine had been received containing potassium hydroxide and inadvertently stored on its side. Warning signs were posted, the machine cleaned, and it was suggested that the manufacturer be contacted in order to prevent future incidents. (2)

6. A group of sailors were becoming "sunburned" after cleaning salt water voids aboard ship. These voids are painted with bituminous paints as a rust preventive. This paint is a type of asphalt coal tar pitch. The photosensitizing effect of this paint is commonly known in shipyards. Detailed information on the subject is found in "Occupational Diseases of the Skin", by Schwartz, Tulipan and Peck. (3)

7. Two cases of apparent sensitization to epoxy resin (Palmer) were reported during the quarter. A dermatitis of the hands and forearms appeared after only a few hours of resin application to a propeller shaft. Full protective clothing, including rubber gloves, was worn. A similar operation conducted approximately 3 months earlier resulted in hand and forearm dermatitis in the same individuals during the third week of handling the Palmer resin. It was recommended that the men involved not be assigned to future epoxy jobs. (13)

8. Several employees from one of our shops used benzene to clean Mine Sweep cables before patching. The procedure used was to soak a cloth with the solvent and wipe the area to be patched. This material is extremely flammable and the vapor is very toxic. Chronic poisoning can result from daily exposure over prolonged periods. Its use can cause an irritation of the skin due to defatting effort. Chronic poisoning can also result through skin absorption. It was recommended that personnel be cautioned to prevent inhalation of the vapor and to be required to wear rubber gloves while using this material. (3)

9. A painter developed an erythematous area after spraying "komul", a bitumastic paint. The paint contains coal tar and a tar distillates that photosensitize the skin. The painter did not use protective cream and thereby became sunburned when his skin was exposed after painting. The use of proper protective creams was suggested for all painters spraying resins.

10. A joiner applying an epoxy resin deck coating has developed a sensitivity to this resin. Employee wore rubber gloves and used protective cream on his hands; both arms were affected as well as small areas on one leg and one ankle. This employee was recently transferred here and gave a history of previous sensitization to epoxy resins. He has been assigned to other duties to avoid contact with uncured epoxy resins. (9)

11. A mixture of kerosene, white lead and trichloroethylene was reported to have caused a mild dermatitis on the hands of a machine shop employee. This mixture, used in a steel cutting process, was said to be necessary for this work and further, that direct hand contact, without gloves, was unavoidable. A recommendation that methyl chloroform be substituted for the trichloroethylene and that a protective hand cream be used, was accepted. (8)

12. Five cases of dermatitis occurred during the application of epoxy resins. Investigation revealed that in four cases there was a disregard of the health procedures established for handling of epoxy resins. The other employee was found to have been sensitized to the resin and was removed from further exposure. The remaining four cases were given treatment and additional indoctrination. (11)

## II. Physical Health Hazards

### A. Exposure to Excessive Heat

1. A study was made of the upper sections of the Machine Shop to determine temperature and humidity conditions existing during the summer months. Although the results did not indicate serious adversity recommendations were made to improve working conditions to maintain production efficiency. (8)

### B. Exposure to Nonionizing Radiation Hazards

1. During this quarter the nuclear reactor of SSGN-587, USS HALIBUT, was brought to initial criticality and the reactor and associated systems were successfully tested at all power levels. No unusual or severe health physics problems developed. None of the workers acquired more than a minimal exposure to ionizing radiation. (2)

2. Microwaves. Under the provisions of a BuMed Instruction requesting eye examinations of radar employees, all the personnel in the radar shop were so examined. Two (2) employees were found with abnormalities; one (1) showed cataracts of both eyes which may have been originally produced prior to his employment at this Station, however, he indicated previous experience as a radioman in the U. S. Navy; the other showed certain opacities of senile character. A survey of their work areas with a germanium diode tester indicated microwave intensities in the order of 0.001 to 0.004 watts per square centimeter during operation of a powerful radar set in a separate area of the shop. Both employees were transferred to "cooler" areas of the shop and were further shielded with metallic partitions resulting in no reading in the detector.

Stray radiations were found in the radar shop as indicated in the paragraph above. These were judged to be within the accepted limits of microwave exposure and resulted from reflections or refractions of microwave beams directed to outside targets through glass windows. Structural members of the building caused some of these rays to bounce back. Recommendations have been made to install absorbing screens around radar antennas in such orientation as to prevent the bounce-back effect. (6)

3. As a practical safeguard to avoid excessive exposure to radar waves, Neon Lights (N. E. 51, Stock #GF, 6240.223-9100) are being used. These neon lights will glow when exposed to microwaves producing approximate energy of 5 or 6 milliwatts per square centimeter which are below the threshold limit of 10 milliwatts per square centimeter. (20)

4. Radar Modulator Unit An-SPS-29, containing high voltage Thyatron Tubes (12 kvp), was monitored aboard the USS MANLY for presence of x-radiation. Readings were taken using "Cutie Pie" ionization chamber encased in a "cage" covered by a double-thickness aluminum screen to prevent RF interferences. Readings in the compartment and in front of the modulator unit with doors open were less than 1mr/hr. Film badges placed on the inside of door panels and on one operator represented 6-8 hours exposure, film badge (duPont 552 packet) readings were negative.

5. Since instrumentation is not avail/able to continuously monitor the area in the vicinity of the antenna where shipyard cranes are required to operate, it is desirable to provide these crane operators with a qualitative measuring device that will show the presence of microwave radiation in the energy range that may constitute a health hazard for continuous exposure. (12)

It is known that miniature neon lamps, such as the GE series NE-51 will glow in the presence of radar microwaves in this energy range. It is recommended that they be installed against the outside front glass

window of the cab in full view of the operator.

(12)

### C. Exposure to Excessive Noise

1. Acoustical measurements on several hydraulic test benches indicate that generally ear protection is needed by the operators of such equipment. The noise exhibits one or more peaks in some octave bands which indicates that either pure tones or narrow frequency ranges exist and thus render the noise more hazardous. For instance, a bench with a measured level of 98 decibels has a hazard equivalent to 108 decibel level. It is felt that wearing of ear plugs is advisable for most of the personnel in the vicinity of these benches and it is mandatory for the operators. This situation presents a difficult enforcement problem and is best solved by installation of acoustical shields when funds will be available. (5)

2. Under the hearing conservation program it is intended to have information on the hearing of every industrially employed person. Overall audiometric surveys of large segments of the Station conducted on a division-wide basis have been initiated. Three divisions have been completed with another one in process. (6)

3. Measurements were made in the metal building at the O&R Jet Test Cell Area. Employees inside the building complained of vibrations in the chest as a result of the operations. The noises were not found to be excessively high for operations of this type. Personnel were informed the vibrations are not injurious and ear defenders are required during the operation. (15)

4. Modification of an existing test cell to accommodate the J-57 engine with afterburner was completed recently. An evaluation of sound attenuation was made by Sound Control Incorporated; sound reduction was not acceptable. Design of the engine support was such that the engine exhaust was approximately 10 feet from the attenuator inlet. Modification is in progress to permit operation essentially as designed. (16)

5. Preliminary checking on the effectiveness of a (Maxim Div. of Emart Company), portable sound attenuating device was done utilizing the A4D-1 aircraft (J-65 engine). It was found that sound intensity was increased forward and the side; and decreased aft of the muffling device. Tail pipe temperature was elevated about 12° probably because of back pressure built up by entry resistance. Alignment was imperfect (inherently so with this attenuator and the A4D) and the attenuator entry grill is of significant area with a consequent build-up of temperature. Indications are that portable mufflers or attenuators of this design are not usable without considerable modification. (16)

6. A noise study was conducted at the Ground Control Approach Facility located near the intersection of the two main runways in the direct path of noise produced in the flight test line, 1500 feet away. A continuous recording indicated a weighted average overall noise of 92 decibels with peaks varying from 108 to 117 decibels. The 20 military persons attached to that facility have been included in the audiometric program and hearing protection has been recommended. (6)

7. Several estimates were made of the expected free-field noise produced by the Regulus II missile utilizing data issued by the manufacturer of other naval sources. It was concluded that noise of the order to 150 decibels may be encountered in areas where personnel will have to perform certain adjustments. Recommendations were made to add water cooling to a standard portable aircraft exhaust muffler, so as to enable afterburner runs exceeding the capability of the muffler. Actual noise readings of the Regulus II made subsequently at Point Mugu indicated the noise to be of the 140 decibel intensity. (6)

8. An attenuation pad consisting of a length of cable and two plugs to be inserted in the corresponding sockets of a sound level meter was manufactured with the assistance of the Navy Electronics Laboratory, San Diego. The device provides 30 decibels attenuation thus extending the range of the sound level meter to 170 decibels. (6)

#### D. Illumination Problems

1. Due to complaints of excess glare from military personnel a survey was made of an office located on an outlying field. Lighting is furnished by overhead fluorescent fixtures equipped with diffusers and furnishing a minimum of 30-40 f.c. of light on the working surfaces. The walls are painted a cream-yellow. Work in the office is done on yellow cards and visual difficulty is encountered due to poor contrast. In order to reduce glare it was suggested that the walls be painted with a dull finish, light green paint. (15)

2. A program for the relamping of certain production areas has been initiated. A survey was recently completed in the second floor of an industrial building where light levels were low, requiring considerable amount of auxiliary lights. At this time the general level of illumination was found to be in excess of 50 footcandles. Because of the extremely high visual demands of certain operations many of the auxiliary lights were recommended to be retained to yield levels in the 100-200 footcandles suggested by the Illuminating Engineering Society for similar tasks. (6)

3. Glare from Fluorescent Red Orange Paint, Color 633, Hi- (20)  
Visibility, was responsible for eye fatigue among several of the 30 spray

painters using this type paint. Tinted glass protective eyewear was recommended as suggested by BuMed and BuAer. Personnel also complained that difficulty was experienced in removing the fluorescent paint from the skin. Protective skin cream (Ply #2) and SBS #30 waterless skin cleanser were recommended and used with good results. (20)

4. Large grinding machines are located on the hangar decks of carriers undergoing conversion. The illumination appeared inadequate. Measurements were taken of the illumination furnished by the lights located on the grinding wheel shield. The intensities on the tool rest ranged from 20-40 footcandles, apparently depending on the type of bulb installed. With the grinder lights turned off, no detectable reading could be obtained on the light meter, indicating that general illumination was practically non-existent. This created a hazard because it is required that lights be turned off when the machine is not in use. A person approaching the machine could not tell whether the grinding wheel was still rotating from previous use or not. The latest recommended illumination intensity for rough grinding is 100 footcandles to be furnished by combination of general and supplemental illumination. It was therefore recommended that the bulbs installed on the grinding machines be of a type to furnish a maximum possible illumination and that general illumination in the area be provided at a level of at least 30 and preferably 50 footcandles. (4)

### III. Ionizing Radiation Health Hazards

1. A survey was made to determine the radiation level in unrestricted areas in the Material Laboratory around Radiographic Room #310. Radiation levels were measured during lead camera type and open source exposures using a 500 mg. radium source. Lead shielding was varied to determine the reduction in radiation levels obtained by the use of various types of lead shielding. Data obtained from the survey (10) disclosed the following:

a. Camera Type Exposures. The maximum radiation levels recorded in the unrestricted areas was 0.28 mr/hr with the camera elevated at 15 inches above the floor. The camera was shielded on the bottom at floor level with 12 x 16 inch area of 2 inch thick lead bricks and with a 4x8x2 inch lead brick on top.

b. Open Source Exposure.

(1) The maximum radiation levels recorded in the

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unrestricted areas were 5.0 mr/hr with the source 15 inches above the floor and shielded by an area of 12x16 inches of 2 inch lead bricks on the floor directly below the source and an area of 10x10 inches of 2 inch lead bricks 15 inches above the source. This shielding is understood to be standard practice.

(2) Measurements made after adding 1½ inch thickness of lead covering an area of 5x5 feet under the 12x16x2 inch lead shield resulted in a maximum recorded level of 1.1 mr/hr in the second floor area directly below the source. This is the same location where the 5.0 mr/hr reading had been previously obtained.

The results obtained from this survey indicate that it is permissible to use the camera type of exposure at any time of the day since the shielding provided attenuates the radiation level to a value below 2 mr/hr in unrestricted areas as required by the Atomic Energy Commission. In regard to the open source exposure, this type of operation is permitted only during off hours providing shielding as indicated in subparagraph b (2) above, adequate portable panel shields installed between the source and the north, west, and east walls of Room #310 and adequate shields above the source are maintained. This shielding is required to retain the "unrestricted" ratings of other areas around Room #310. In regards to the shielding required above the source, it is considered that an additional ½ inch thickness of lead used together with the 2 inch bricks presently employed will assure compliance with the Atomic Energy Commission regulations. It was understood that a new method of shielding will be provided in the near future. This shielding will be placed closer to the source. The effect of the new type of shielding will be surveyed and if found satisfactory will then be used as standard in open source exposures. It was recommended that supervisory personnel check and approve the application of shielding prior to exposing the various sources to assure maximum safety of laboratory personnel. (10)

2. This office assisted Code 74 of BuMed in exposing film badges to AN/SPS-8A and Mark-25 radar scopes. Duplicate film packets on the AN/SPS-8A exposures were forwarded to the Commanding Officer, Naval Medical Research Laboratory, Bethesda, Maryland. Dosage recorded on duPont 552 film was not detectable even on film placed on the antenna for 15 minutes. Pocket dosimeters (IM-9D/PD-200 mr scale) were placed in all locations for the same time interval; no dosages (less than 1 mr) were observed. (12)

3. Radioactive Luminous Paint Containing Radium Salts. Radioactive luminous paint has been used by the Engraving Section of Shop 51 to paint numbers on telephone dials. Since this paint is no longer used the shop on recommendation of the Medical Department disposed of it through an Atomic Energy Commission approved waste disposal (10)

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concern. Measurements with radiac set AN/PDR-27 revealed traces of radioactive residues where parts had been stored, mixed or used. All areas where contamination was found were wiped by an employee wearing rubber gloves, using small squares of cloth wetted with a wash solution containing a detergent and chelating agent, Versene. More stubborn areas were scrubbed with a 1-inch square brush and then wiped repeatedly. Some areas, such as those on porous wood which could not be cleaned as above were removed by sawing away around that area and removing that section of wood. This procedure was also followed in the case of a linoleum-topped table and a masonite covered work bench. All cloth used, brush, sawed-off pieces and rubber gloves were collected in a plastic bag and disposed of in a radioactive disposal can in an unfrequented open area to await removal by a disposal contractor. All areas were cleaned until the reading was less than 0.05 mr/hr and a wipe test using damp filter paper showed no removal of radioactivity from the surface.

It was recommended that radioactive material, chemicals or paints should not be used until the Industrial Hygiene Division has investigated proposed use and recommended control measures necessary to minimize exposure of personnel and contamination of work areas. (10)

4. Cobalt 60, Cesium 137 and Radium 226. New carrying cases are being built for the radioisotopes used for shipboard radiography. These are designed to conform with U. S. Atomic Energy Commission, AECU-2967 Radiation Safety in Industrial Radiography with Radioisotopes. This specified that the level of radiation from gamma emitters should not exceed 200 mr/hr at the surface of the outside of the container and/or 10 mr/hr at a distance of one meter from the source. One carrying case built to carry 2,000 millicuries of cesium 137 has been completed and was checked for compliance with the requirement. A Gamma meter read 200 mr/hr at the surface of the container. As other containers are built they will also be checked for conformance with AECU-2967. (1)

5. Plutonium 239. A barge used for the disposal of radioactive waste at sea became contaminated from a leaking container. A cement block approximately 4 feet square and 8 feet long was delivered by truck to the enclosure reserved for the storage of radioactive waste. Soluble plutonium apparently percolated through the cement, contaminating the truck bed and eventually the barge.

A survey of the 5 hopper areas of the barge was made to determine the extent of contamination. The contaminated barge areas were heavily rusted. When taking samples it was noted that surface readings were reduced about ten times by scraping with paint scrapers. Total contamination was estimated to be about 100 microcuries located for the most part in two of the five hoppers. (1)

Decontamination of the most highly contaminated areas by scraping appeared to be possible. A vacuum cleaner was designed and built from commercial vacuum cleaner parts and sheet metal. A second vacuum cleaner was borrowed from the Naval Radiation Defense Laboratory. The filters installed were capable of filtering out particles down to 0.3 microns in diameter.

The barge was drydocked and allowed to dry out. Areas of contamination in excess of 500 d/m/150 square feet were outlined with chalk. Heavy Kraft paper was laid over the bottoms of the hoppers and secured to the edges with pressure sensitive tape. The marked areas were scraped a square foot at a time. The scraped surfaces and the surface of the Kraft paper were then cleaned with the vacuum cleaners. Occasional slight contamination was found on the booties worn by personnel entering the hoppers.

All personnel entering the hoppers were required to wear Scott Pressure-Demand air supplied respirators. These respirators were found to be excellent for both protection and comfort.

After the highly contaminated areas were decontaminated the hoppers were wet sandblasted. Air contamination during sandblasting was well within the maximum permissible concentration for airborne plutonium.

A complete report can be obtained by writing the Industrial Hygienist of the Command. (1)

6. A radiological environmental survey has been initiated in order to establish the background levels in the Pearl Harbor area. Samples of air, potable water, harbor water, soil, vegetation, and harbor mud, are collected periodically and examined for gross beta activity. The frequency of sampling has been limited by the lack of adequate personnel and equipment, but it is expected that these deficiencies will be corrected within the near future. (19)

7. A group of 10 Passive Defense trainees were engaged in certain exercises involving isotope handling. Photodosimetry indicated total exposures varying from 0 to 0.02 milliroentgens. (6)

8. Because of the very infrequent use of the Radium Painting room, it was planned to make that area available to an instrument shop and to remove or tie-up part of the present exhaust ventilation system (6)

to the instrument shop ventilation which will operate with a large degree of recirculation. This proposal has been strongly opposed because of the possibility of disseminating residues that may exist in the present system and because there is still need for limited radium handling facilities. (6)

**B. X-Rays**

1. Ten (10) film badges were given varied exposures to a known amount of x-ray radiation using an AN/PDR 2 radiac set. On developing and reading the film badges the error was found to be about 10% on the high safe side. This was probably due to using exposure graft No. B 552-180 with film No. B 552-205. This information was discussed with the Industrial X-ray Technicians. They appear to have an increased confidence in their film badge radiation exposure results. (3)

**C. Alpha Particles**

**D. Gamma Particles**

1. During trial operation of ANSPS/29 radar unit aboard ship, film badges were posted on and around the power components, as well as on Electronic Ship personnel working in the area as a protective measure against the possible over exposure to X-- radiation. Films evaluated after 2 to 3 hours of exposure revealed little or no density readings above control films, while film exposed for approximately 40 hours indicated up to 0.03 roentgens of X-- radiation. (8)

**E. Isotopes**

1. This shipyard became aware that under the Atomic Energy Commission license for operating the various radioactive isotopes, the disposal of low level wastes even if performed in accordance with NAVMED P-1325 is a violation of Title 10 of the Federal Register (Chapter 1, Part 20). Consequently this office recommended the contracting of an AEC authorized contractor for disposing of this waste. It is believed that the contractor, Nuclear Engineering Corporation, Kearney, New Jersey, is performing a function more expeditiously and economically than has been done in accordance with Bureau directives. (12)

**F. Radioactive Waste Material**

1. Because of security requirements, the previous radiological disposal area had to be relocated at a point beyond certain distance from a classified installation. The new area was cleared of underbrush, surrounded by a wire fence and a pad-locked gate and will enclose the reinforced concrete cylinders where radioactive waste material is deposited for final cement sealing and ocean disposal. Since the previous area (6)

was active from the time the liquid wastes were disposed, a very small level of ground contamination exists. Therefore it was recommended that the previous area be left as is, without access to any unauthorized person, and that it be permanently charted as contaminated in all future condition maps. Two (2) employees are currently collecting and disposing of radioactive waste material, mostly electronic tubes. Their photodosimetry was normal. (6).

#### IV. Shipboard Industrial Hygiene Surveys and Investigations

##### A. Surveys

1. A ventilation survey was made on a ship under conversion. Readings from a number of 5 inch flexible tubes indicated an average ventilation rate of 456 cfm. The method used to obtain this ventilation rate may be of general interest. Seven (7) platforms are installed along the hull at the third deck level to hold the ventilation machinery. Holes for 16 inch ventilation ducts are cut in the hull of the ship. These are joined to vertical 16 inch ducts which extend from the main deck to the tank tops. Each level has four to six branches as required for attaching the 5 inch ventilation tubing. The system was designed so that any part of the ship could be reached with 60 feet of 5/2 ventilation tubing. (1)

#### V. Substitution of Toxic Solvents by Less Toxic Material

#### VI. Notes

This section will include items of interest ranging from the scientific to the social aspects of the Occupational Health Program.

##### A. Miscellaneous

1. Investigation of contamination of Liquid Oxygen (over 30 ppm CH<sub>4</sub>) revealed that the Samplers were contaminated with CH<sub>4</sub>, CO<sub>2</sub> and N<sub>2</sub>O as analyzed with the Beckman Infrared Spectrophotometer IR4. After proper purging no contamination was found in the samplers. The Samplers were procured from the Naval Air Station, Alameda, in a contaminated state. BuAer was notified to alert other activities that might have received the same lot of Samplers. (20)

2. A considerable part of the Industrial Hygienist's time, in addition to their most important function (to evaluate environmental occupational health hazards and recommend engineering and personal control measures for the prevention of illness and absenteeism), is occupied in investigating conditions alleged to be uncomfortable or health hazardous. These investigations are important. They often result in preventing (15)

unjust compensation claims by producing facts substantiating the lack of basis for a complaint. In practically all instances these investigations of complaints or alleged health hazards result in alleviating fear of employees and thus contributes to production efficiency and morale. Following is an example of such an investigation:

A crystal etching shop (ammonium bifluoride solution) has ceased operations and the work space has been used by an electronics shop for a number of months. Several employees complained of nausea on a Saturday following a routine work week. The area was cleaned before operations transferred and only the sinks are in place. No complaints of this type had been made during the previous years the shop was used. Personnel were informed symptoms could not be caused by hazardous conditions in the shop. (15)

3. Enlisted personnel aboard the Norfolk Reserve Fleet became intoxicated due to lack of proper protective equipment while spraying. Proper protection and ventilation requirements were enumerated to the personnel in order to prevent the condition recurring.

4 The Gyro-Compass Shop was razed in a beautification program. While most of the rubble was still on the site, the area was monitored for mercury vapor in the air. The air concentrations ranged from .0 to 0.4 mg/m<sup>3</sup> using a Kruger Mercury Vapor Detector Model #23. Chemical analysis of the dirt in the building revealed only micro quantities present. Years ago the building had been used to manufacture antifouling paint when mercury oxide was a common ingredient in that paint. After clearing the area and leveling the ground, dirt samples showed no mercury nor was there any air concentrations in the air concentrations in the area. A Beneficial Suggestion recommending that the demolished building material be specially handled due to the mercury hazard was returned disapproved. (12)

5. Malfunctioning of sensitive guidance instruments has been attributed to the presence of dust particles in the system. Because the presence of particulate matter in atmosphere is one of the possible sources of these particles industrial hygiene methods were used to determine the dustiness of the air in a new, air conditioned, instrument shop. The dust counts ranged from .75 to 2.5 million particles per cubic foot of air. The dust electrostatically precipitated on a hemocytometer cell ranged in size from submicron particles to pieces as large as 500 microns. These values are far in excess of the criteria for the instrument shop which specify less than 0.25 million particles per cubic foot of air with the particles not to exceed 0.3 microns in size. This excessive dust loading is, of course, not significant in terms of a health hazard, but is tremendously important in terms of the integrity of the aircraft (5)

instruments or of guidance systems. Thus, by applying standard industrial hygiene methodology it was possible to locate the dust sources within the shop, as well as other channels of entry and to make recommendations for changes in work methods, relocation of potentially dusty or particle generating processes, improvements in the air cleaning systems, etc., which will result in the eventual control of this problem. (5)

6. Urinary leads were performed on a weekly basis for a group of men cleaning gasoline tanks on an outlying island. This laboratory work was considered highly desirable because of the occurrence of several cases of lead poisoning on the previous occasion when these tanks were cleaned. Samples were shipped by air in polyethylene bottles and arrived without spillage or leakage. All lead values were within normal limits, and no symptoms of lead poisoning developed during or after the tank-cleaning job. (19)

7. A case of metal-fume poisoning occurring during shipboard welding on galvanized material is believed to have been due to an unauthorized change in the temporary ventilation set-up. One of the two "suckers" used in the area was reversed so as to blow air into the compartment to provide a more comfortable working environment. The cross currents so produced interfered with fume collection by the remaining "sucker". Supervisory personnel are taking steps to prevent a recurrence of such an unauthorized change in ventilation set-ups. (19)

8. A request was received from the Fairmount Glass Works of Indianapolis to advise on heat control at their glass manufacturing operations. The request was peculiarly channeled through the Secretary of Defense on down to this Command. A letter giving general guidelines on the control of radiant heat which was judged to be the major contributor to the problem and references for literature and specialists that may be directly available to the Indiana glass industry, was prepared for the signature of the Commanding Officer. (6)

9. A paper presented at the meeting in Chicago indicated that propane gas may contain too little odorant to warn of explosive mixtures. This information was imparted to the Shipyard since we use propane at this activity. Tests are underway to determine the concentration of the odorant in the local propane. (4)

10. An instruction for labeling of hazardous chemicals has been published by the Naval Air Basic Training Command, and will be implemented by subordinate activities at an early date. (15)

11. A Beneficial Suggestion was investigated which advocated revision of several of the Navy-wide standard labels. It was found that writing on some labels is illegible because of the color of the (4)

label. The Beneficial Suggestion was approved. However, it was noted that these labels are Navy-wide in distribution and must be changed by the originator of the present system. (4)

12. A leaking drum of hydrofluoric acid Stock No. G6810-236-5671 was reported from the Supply Department bulk storage area. Investigation revealed that 5 additional drums were potential leakers as indicated by bulging and general appearance of the drums. These 6 drums were drawn and used by the plating shop. Stock quantity will be limited not to exceed a normal 6 months supply with isolated storage in a well ventilated area. Personnel in the area have initial indoctrination on potential hazards, preventive measures and first aid procedures. (16)

13. We are attempting to maintain a continuous health educational program for our asbestos workers. The shop has been most cooperative in this effort. The film, "The Air We Breath", was obtained from MSA and shown on four occasions to small groups of these employees. This educational movie was followed by a short discussion of the hazards of breathing asbestos fibers and the use of dust respirators. (3)

14. A Safety Order was written providing specific instructions for the storage, use, handling, and cleanup of mercury. In each section of the instructions it was stressed that the basic principal of controlling exposure to mercury is containment. (2)

15. A pre-operational environmental survey for background radiation levels in the Shipyard area was initiated July 1st. in preparation for future nuclear submarine overhaul. Air, river water, potable water and rainfall samples are being collected. The Shipyard program is coordinated with a State Health Department survey which will cover areas outside the confines of the Shipyard. A total of 8 weeks of on-the-job training in radiation protection procedures is being received by three members of the Industrial Hygiene Division at Portsmouth Naval Shipyard in conjunction with the Nautilus overhaul. (13)

16. The U. S. C. Safety Supervisor requested information about the hazards involved in cleaning up a dry spill of Calcium Hypochlorite. It was recommended that the Calcium Hypochlorite be removed by dry methods and that workmen doing the cleaning be provided with respiratory protection (1)

#### B. Personal

1. An excellent article titled, "Radiation Hazards Aboard A Guided Missile Cruiser", by Johnson, W., Kindsvatter, V. H., and Shaw, C. C., appeared in the United States Armed Forces Medical Journal, (BuM)

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Volume X, No. 5 of May 1959. Victor H. Kindsvatter is the senior civil service industrial hygienist of the medical department of the Philadelphia Naval Shipyard. Several other industrial hygienists have had articles published in such periodicals as the Armed Forces Medical Journal, Safety Review, and professional industrial hygiene publications in the past year. Among these are Mr. Ernie Storlazzi of Boston Naval Shipyard, on welding; Dan Bessemer of Bremerton Naval Shipyard, in ventilation control of duplicating processes; Harry Gilbert, New York Naval Shipyard, on inert gas electric welding; Alfredo Salazar, Naval Air Station, San Diego, on industrial hygiene surveys in "Safety Review", to mention a few. Beginning this year - 1960 - the Notes will list the articles and publications, so that readers of these releases will be informed of articles published by U. S. Navy officer and Civil Service Industrial Hygienists.

2. An article by Mr. Jack McElhiney, senior industrial hygienists of the San Francisco Naval Shipyard, on an unusual experience in the decontamination of a radioactive waste disposal barge will appear in the Naval Medical News Letter, Volume #35, No. 3, of 5 February 1960.(1)

3. Mr. Charles P. Bergtholdt of the Naval Weapons Plant, Washington, D. C., has developed an interesting and effective pictorial presentation of the industrial health program conducted at the Weapons Plant. The presentation consists of attractive posters depicting the various services and functions of an occupational health team. (18)

4. Ships and those naval activities not having industrial hygienists attached can obtain the services of a qualified industrial hygienist for a periodic industrial hygiene survey by requesting the Commanding Officer of the nearest naval activity having an industrial hygienists, for this service. Requests are processed via the cognizant District Commandant, (see NCPI 88.8-4) and Manual of the Medical Department (CH 26-10). Any financial arrangements required are made by the Commands. During the quarter some of the surveys reported are as follows:

Bermuda	
USNAS Oceana	Mr. Herbert J. Worsham
NAS Whidbey Island	Mr. D. J. Bessemer
Naval Research LAB	Mr. Ray McClure
USS HOLMES COUNTY (LST 836)	Mr. Alfredo Salazar & Harry Utes
ARC- Cable Layer Ship	LCDR Wm. H. Dentler, MSC, USN
USN Underwater OrdSta, R.I.	Mr. Salazar DiLustro

USN STA Key West

Mr. Roland Byrd

Medical & Dental X-ray  
aboard ships berthed  
in Shipyard - Norfolk

Mr. Seymour Levinson

NavSupCen Oak and

Mr. Jack McElhiney

USS ANTIETAM Survey

CDR Ray Nebelung, MSC, USNR

USN TraCen, Bainbridge

LT C. J. Jordan, MSC, USN

5. A survey was made by the Norfolk Naval Shipyard industrial hygienists of the concentration of mercury vapors in the Cardio-Pulmonary Function Laboratory at the U. S. Naval Hospital, Portsmouth, Virginia. (12)

6. A noise survey is being conducted aboard the USS ANTIETAM. Sound measurements are being made at various locations on the flight-deck and throughout the ship. (15)

7. The industrial hygiene division of the medical department, Portsmouth Naval Shipyard, has expanded considerably to provide the extensive monitoring, laboratory, and industrial hygiene advisory services necessitated by refueling and overhaul of the SS(N) NAUTILUS and completion of the nuclear powered submarine &SS (N) SEADRAGON. To provide industrial hygiene coverage on a three shift, seven day week basis, has required a division staff total of fifty-one, - forty-four of whom were directly employed in the radiological health monitoring and the rest for supportive laboratory and general industrial hygiene duties. To supplement the small permanent staff, 34 Production Department employees were detailed to the division and trained for radiological monitoring work.

There are several principle radiation or contamination areas subject to industrial hygiene monitoring control. At the USS (N) NAUTILUS for work in the reactor compartment a personnel change barge has been provided.

This barge contains facilities for issuing protective clothing, film badges and dosimeters, a clothing change area with lockers, and a health physics room with facilities for industrial hygiene survey instruments, laboratory bench for scalars to count air samples, swipes, and other samples, and located to enable control of personnel both in and out of the lower reactor compartment. This is the control point of industrial hygiene service for the NAUTILUS overhaul. All work areas are continuously monitored for radiation level, air concentrations, and surface swipes for loose contamination. All personnel leaving contamination (9)

areas are monitored to assure radioactive cleanliness, and all equipment or waste is monitored and appropriately tagged. (9)

8. Herman Schulz, formerly associated with the New York State Department of Labor, Division of Industrial Hygiene, has been appointed to fill the vacancy of Assistant Industrial Hygienist. (10)

9. Four new positions have been established in the Industrial Hygiene Division of the Medical Department for the following: Industrial Hygienist, GS-11, Health Physicist, GS-11, Radio Chemical Technician, GS-7, and Clerk Stenographer, GS-4. It is expected that the positions will be filled within the next quarter. (19)

10. Courses of instructions in Industrial Health were given classes of Flight Surgeons and Aviation Medical Technicians at the School of Aviation Medicine. (15)

11. Mr. Harry F. Roegner reported aboard as an industrial hygienist trainee on 24 August 1959. (4)

12. The annual industrial hygiene survey of the U. S. Naval Underwater Ordnance Station, Newport, Rhode Island, was conducted by the Industrial Hygienist of the Naval Air Station, Quonset Point. (20)

13. The industrial hygienist recently spent two weeks at the Portsmouth Naval Shipyard in on-the-job training in the Industrial Hygiene Division of the Medical Department, for nuclear work. An opportunity was afforded to observe the procedures for contamination control and personnel protection during overhaul work on the NAUTILUS. Information was also obtained on the organization of the Health Physics Branch, personnel matters, field and laboratory equipment, analytical procedures, dosimetry, medical clearance, waste disposal, and limits of exposure and contamination. (19)

14. Radiac coordinators from various shipyards and other naval installations visited this shipyard for training in regard to the neutron calibrating range developed here. A brief talk was given on the Health Physics aspects of the range. (2)

15. Included in a Middle Management supervisor training course were talks by the Industrial Hygienists and the Health Physicist to acquaint the trainees with the philosophies, terminologies, and activities of the respective disciplines. (2)

VII. Composition Data ( information will be found on separate page)

VII. Composition Data

A. The following data is to be treated as "Commercially Discreet" information and is to be used for official purposes only:

1. In accordance with SECNAV Instruction 6260.3 and BUSHIPS Instruction 6260.3 on labelling toxic materials. The following new materials were introduced into the shipyard and assigned a label accordingly:

Penetone Formula 426 - cresylic acid 15%, chlorinated solvents 45% label BuSandA 9987.

Pero-Klean Marine Cleaner #801 - high flash aromatic hydrocarbon oil, label BuSandA 9987.

Miracle Mastic Type P - solvent is Petrolene, label BuSandA 9988.

Hy-Temp Block Insulation - diatomaceous earth 63-70%, asbestos fiber 12-15%, no label.

Foster 81-33 Fire Resistive Adhesive - xylol 41.5% by volume, alkyd short oil 23%, BuSandA 9988.

Carlton PVC Cement and Primer - tetrahydrofuran 66%, label BuSandA 9988.

Fabertite - Contains coal tar, label BuSandA 9987. (12)

2. Other products:

Pressure Sensitive Tape, No. 428C, manufactured by the Minnesota Mining and Manufacturing Company contains no ketones, phenols, aldehydes or other material that would be suspected of causing skin irritation or sensitivity. (9)

Porselon #600 is a two component coating manufactured by Protex-A-Cote Incorporated. Segment #1 contains 50% resin and 50% technical grade amyl acetate by volume. Segment #2 contains 50% aliphatic amine and 50% amyl acetate by volume. The combustion products would contain amines, carbon monoxide, carbon dioxide and cyanides. (9)

Formula 121X paint.

This formula contains more solids than Formula 121 and in addition contains a significant amount of tricresyl phosphate. (4)

Aircasil Flux. Used in silver soldering. Qualitative tests for boron were positive. Fluorides were present (approximately 10%). PH of the mixture is about seven. It contains about 65% water. Appears to be similar to Handi-Flux which contains about 11% fluorides and has a pH of 6.8. Flame tests showed no sodium or calcium. (4)

Pitt Chem Thinner - manufactured by the Pittsburgh Coke and Chemical Company is a high boiling heavy grade solvent naphtha (aromatic). (9)

Glass Cote Sealer - distributed by Robert J. Elliot, Boston, Massachusetts, was found to contain excessive amounts of Xylene. No precautionary measures for use of this material was stated on the label. (8)

Durapox - a two component epoxy resin product is manufactured by the Durant Paint, Incorporated, Revere, Massachusetts. Durasol is the name of the associated polyamine hardener. (8)

Stripper C86-67D. Turco Products Co. Contains 48% sodium monosilicate pentahydrate, 48% sodium trisilicate and 4% sodium resinate and cresylic acid added. (6)

Cleaner, Mil-C-16553, Type I - A clear solution of ammonium and amine soaps with or without a hydrocarbon solvent. (5)

Acrylic cellulose - nitrate lacquer, Mil-L-19537 - Methyl methacrylate, diisooctylphthalate, ketone, alcohol, toluene. (6)

Denatured ethyl alcohol, JAN-A-463 - Ethyl alcohol to which has been added dye or denaturant (C-1 grade). (6)

Potting compound MIL-S-8516B - Base, polysulfide rubber, 55% in aromatic hydrocarbon. No benzene shall be used. (6)

Turco 2822. Turco Products Company - A general paint remover and deseculant for neoprene and thiokol adhesives. Contains chlorinated hydrocarbons. (6)

Acrylic lacquer, Mil-L-19538 (Aer) - Methyl ethyl ketone, methyl isobutyl ketone, octane, isophorone, cellosolve acetate, toluene, nitrocellulose compounds, methyl methacrylate, dioctyl phthalate. (6)

Acrylic thinner, Mil-T-19544 (Aer) - Cellosolve acetate, 20%, methyl isobutyl ketone, 40% and toluene 40%. (6)

Alodine 1200 - Mixture of chromic acid, simple and complex fluorides and phosphoric acid. (6)

Black phenolic resin, Mil-R-3043 - it shall not contain chlorinated compounds or benzol and shall not have an irritating or nauseating odor. (6)

Camouflage lacquer, Mil-L-006308 - a cellulose nitrate lacquer. (6)

Cellulose nitrate lacquer, Mil-L-7178 - Non-oxidizing phthalic alkyd resin, diisooctyl phthalate butyl acetate, ethyl acetate, butyl alcohol, toluene, naphtha. (6)

Cellulose nitrate thinner, T-T-T-266A - may contain methyl isobutyl carbinol, methyl ethyl ketone, methyl isobutyl ketone, toluene. (6)

Cellulose acetate butyrate dope, Mil-D-5551D - Cellulose acetate butyrate, plasticizer, butyl acetate, diacetone, ethyl acetate and methyl ethyl ketone. (6)

Cellulose acetate butyrate thinner, Mil-T-6097A - Butyl acetate and diacetone alcohol. (6)

Compound grease cleaning solvent, "gunk", Emulsion Type II, Phenolic. Fatty acid soap 51%, cresylic acid 16%, butyl alcohol 1%, hydrocarbon oil (Kerosene) 32%. (6)

Day Glo fluorescent paint, Mil-P-21563 (Aer) - Acrylic resin and aromatic thinners. Contains no ketones, cellosolve acetate or mineral spirits. (6)

Deoxidene - Phosphoric acid (75%), butyl cellosolve and 1% nonionic wetting agent. (6)

Nacconol detergent wetting agent - Sodium alkyl aryl sulfonate. National Aniline and Chemical Company (6)

Nubelon enamel (Glidden Paint Co.) - A silicone epoxy paint with accelerator added. Cures at 425 - 450° F. (6)

Parko Lubrite - Phosphoric acid for surface treatment (205-210° F.)

Nokorode 731 - referred to locally as Paralketone, Mil-C-16173A Corrosion preventive solvent cut back. skin irritant. 60% asphaltic base, 40% mineral spirits. Lion Oil Company. (6)

Polyurethane (Magna) S.671. (Sherwin-Williams Co.) - Polyisocyanate reacted with hydroxyl bearing resins in a solvent system, reported as non-toxic and non-irritating. (6)

Preservation oil, Mil-O-6083 - a petroleum base oil with tricresyl phosphate and inhibitors. Tricresyl phosphate is a toxic material. (5)

Preservation Oil AN-C-124C - a corrosion preventive compound (non-volatile) dispersed in petroleum solvent. Benzol and chlorinated hydrocarbons are excluded. (6)

Pretreatment coating (Glidden) Mil-C-8514 (a) Glidden Paint Co. Polyvinyl butyral resin, zinc chromate, magnesium silicate, lampblack, butyl alcohol, ethyl alcohol, acid component, phosphoric acid, water, ethyl alcohol. (6)

The resin: polyvinyl alcohol, 10-20%, polyvinyl acetate 1-1.5%, volatile 80-92%. (6)

Rubber Adhesive, Mil-A-5092A - reclaimed rubber, neoprene or Buna-N is an aromatic solvent (Toluene). (6)

Rubber, Goodyear, Chemigum, Mil-S-7502B, Class B-2 (Aer), Goodyear Rubber Company. A synthetic rubber of the polysulfide type and a curing compound not dependent upon solvent evaporation. (6)

Spraylat (Spraylat Corp.) - plasticized resins and less than 1% ammonia sprayed as a translucent protective coat on plexiglass canopy. (6)

Strippers C-67D, Mil-R-7751A - for stripping steel or anodized aluminum; sodium monosilicate pentahydrate 48%; sodium trisilicate 48%; sodium resinate 4%; pH-11.5-12.5; 22.5-25% by wt. sodium peroxide. (6)

Stripper C-85 - Cresylic acid.

Transpo. Turco Products Co. - a two phase cleaner containing methylene chloride and cresol in the lower layer and water in the upper. (6)

Turco, 3002A. Turco Products Co. - a phosphoric acid brightener.

Turco, 3087C - a phosphoric acid brightener for aluminum. (6)

Turco, 4228 - a strong caustic for grease and carbon removal.

Vinyl paint for silk screen process MIL-D-8634A and Mil-P-8793, ASC - Vinyl resins and plasticizer 20%; isophorone 1%, petroleum naphtha 20%.

Westcoat clear #202, Jan-C-149-Type II, Western Coating Company (Improperly referred to as Eronel). It is a cellulose acetate butyrate compound corrosion preventive. Also contains plasticizers and stabilizers.

Sealant, Mil-S-7502 - a synthetic rubber of the polysulfide type sealing compound and a separate curing agent. (6)

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\* Numbers in parenthesis listed throughout this Report refer to the following stations:

- (1) NSY San Francisco, California
- (2) NSY Mare Island, California
- (3) NSY Long Beach, California
- (4) NSY Puget Sound, Bremerton, Washington
- (5) NAS Alameda, California
- (6) NAS San Diego, California
- (8) NSY Boston, Massachusetts
- (9) NSY Portsmouth, New Hampshire
- (10) NSY New York, New York
- (11) NSY Philadelphia, Pennsylvania
- (12) NSY Norfolk, Virginia
- (13) NSY Charleston, South Carolina
- (14) NAS Norfolk, Virginia
- (15) NAS Pensacola, Florida
- (16) NAS Jacksonville, Florida
- (17) NAS Corpus Christi, Texas
- (18) NWP Washington, D. C.
- (19) NSY #128, Pearl Harbor, Hawaii
- (20) NAS Quonset Point, Rhode Island
- (21) NAD Crane, Indiana

enclosure (1)

Acidic gases, in decomposition of paint, p. 158, item 3  
Acrylic cellulose - nitrate lacquer MIL-L-19537, p. 184, item 2  
Acrylic ester base paint, p. 158, item 3  
Acrylic lacquer, MIL-L-19538 (Aer), p. 184, item 2  
Acrylic thinner MIL-T-19544 (Aer), p. 184, item 2  
Aircasil flux, p. 184, item 2  
Alcohol, p. 184, item 2  
Alcohol, ethyl, p. 186  
Alcohol, ethyl, denatured, p. 184, item 2  
Aldehydes, in decomposition of paint, p. 158, item 3  
Alkaline gases, in decomposition of paint, p. 158, item 3  
Alkyd short oil, p. 183, item 1  
Alodine 1200, p. 184, item 2  
Aluminum alloy No. 55-56, welding of, p. 164, item 27  
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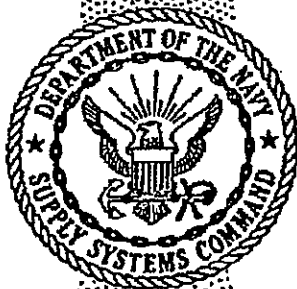
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# **Exhibit 26**



NAVSUP Publication 4500  
COG I Stock No. 0588-005-0000  
VOL. 1 of 1

**N**  
**A**  
**V**  
**Y**

# CONSOLIDATED HAZARDOUS ITEM LIST

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## IMPORTANT NOTICE

This publication supersedes NAVSUP  
Publication 4500 of 1 September 1967  
and FMSONOTE 4410 of 7 March 1968.

1 OCTOBER 1969

## Consolidated Hazardous Item List

### INTRODUCTION

#### GENERAL

The Navy CHIL (Consolidated Hazardous Item List) is published to:

1. Provide all Navy users with a consolidated listing of potentially hazardous items in the supply system.
2. Provide a standard set of codes and definitions to identify the hazardous nature of these items.
3. Provide warning labeling criteria/requirements in accordance with MIL-STD-755A.
4. Provide shipboard storage requirements in accordance with NAVSHIPS Technical Manual, 250-000, Chapter 9300.

### FOREWORD

The CHIL (Consolidated Hazardous Item List) covers items in the Navy Supply System designated as hazardous to life and/or property, not elsewhere classified or identified by specific instructions.

This publication contains (1) identification data, (2) labeling data in accordance with MIL-STD-755A, and (3) ship storage requirements in conformance with NAVSHIPS Technical Manual 250-000, Chapter 9300.

The CHIL does not cover items which are under the control of specific instructions with regard to marking, identification, use, handling, and/or storage. Items excluded are in the following categories:

Ammunition, Explosives, and Warfare  
Chemicals and Gases

Conventional Bulk Fuels

Drugs and Chemicals used or dispensed  
by Medical Department Pharmacies

Reagents and Chemicals used by Clinical  
and Chemical Laboratories

The CHIL does not provide for shipping label information. Information and requirements for labeling and/or marking of containers for shipment are covered in NAVAIR MANUAL 15-03-50q, and Agent T. C. George's TARIFF No. 19.

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## Consolidated Hazardous Item List

## INTRODUCTION

## IDENTIFICATION

## 1. General.

Any material which softens, flows or melts over a range of temperatures (no precise melting point) shall be considered as a liquid (e.g. greases, waxes, pastes and soft, syrupy amorphous material).

## 2. Codes and Classifications.

STD NAVY CODE	HAZARDOUS CLASSIFICATION
B	FLAMMABLE COMPRESSED GAS
C	CORROSIVE LIQUID
F	FLAMMABLE LIQUID
G	COMBUSTIBLE LIQUID
H	HAZARDOUS SUBSTANCE
J	OXIDIZING MATERIAL
M	MAGNETIC MATERIAL
P	POISON
Q	EXTREMELY FLAMMABLE LIQUID
R	RADIOACTIVE MATERIAL
S	COMBUSTIBLE AND TOXIC SUBSTANCE
T	TOXIC SUBSTANCE
W	NONFLAMMABLE COMPRESSED GAS
X	RADIOACTIVE AND MAGNETIC MATERIAL
Z	FLAMMABLE SOLIDS

## 3. Definitions.

## COMBUSTIBLE AND TOXIC SUBSTANCE - Code S

Any liquid which presents a combined hazard due to its combustibility (over 80 and including 150 degrees F) and its toxicity.

## COMBUSTIBLE LIQUID - Code G

Any liquid which gives off flammable vapors above 80 degrees F to and including 150 degrees F as determined by flash point with Tagliabue's Open-Cup Method as used for testing burning oils.

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## Consolidated Hazardous Item List

## INTRODUCTION

## IDENTIFICATION

## CORROSIVE LIQUID - Code C

Any acid, alkaline, caustic liquid and other corrosive liquids which when in contact with living tissue, will cause severe damage to such tissue by chemical action; or which in case of leakage, will materially damage equipment, cargo or other inanimate surfaces by chemical action; or are likely to cause fire when in contact with either organic matter or with certain chemicals.

## EXTREMELY FLAMMABLE LIQUID - Code Q

Any liquid which gives off flammable vapors at or below a temperature of 20 degrees F, as determined by flash point with Tagliabue's Open-Cup Method as used for testing burning oils.

## FLAMMABLE LIQUID - Code F

Any liquid which gives off flammable vapors, above 20 degrees F, to and including 80 degrees F, as determined by flash point with Tagliabue's Open-Cup Method as used for testing of burning oil.

## FLAMMABLE COMPRESSED GAS - Code B

Any gas which when mixed with air in any proportion will burn and which has one or more of the following criteria: (1) an absolute pressure in the container either exceeding 40 pounds psi at 70 degrees F, or exceeding 104 pounds psi at 130 degrees F, or both; or (2) Reid vapor pressure (for flammable liquids) exceeding 40 pounds psi at 100 degrees F.

## FLAMMABLE SOLIDS - Code Z

Any solid material, other than one classified as an explosive, which is liable to cause fire through friction, absorption of moisture, spontaneous chemical changes, retained heat from manufacturing or processing, or which can be ignited readily and when ignited burns with a self-sustained flame; or any solid material which is liable to cause fire through friction, percussion or an electrical spark if it ignites and burns at an ambient temperature of 80 degrees F or less.

V

# Consolidated Hazardous Item List

## INTRODUCTION

### IDENTIFICATION

#### HAZARDOUS SUBSTANCE - Code H

Any substance or mixture of substances which does not meet the definitions as stated herein, but which is (1) toxic, (2) corrosive, including materials which are marked, "mildly corrosive, or "corrosive when wet"; (3) an irritant; (4) a strong sensitizer; (5) combustible (over 150 degrees F), (6) products which generate pressure through decomposition, heat or other means, such as mercury batteries, liquid yeast, polymerizable materials, (7) any liquid under pressure, not elsewhere classified, and (8) compressed gas cylinders labeled as empty, if such substance or mixture of substances may cause substantial personal injury or substantial illness during or as a direct result of any customary or reasonable anticipated handling or use.

#### MAGNETIC MATERIAL - Code M

Any magnetic material or device, such as magnets or magnetrons, which emit magnetic fields of sufficient force to require special handling precautions to prevent damage to magnetically sensitive instruments.

#### NONFLAMMABLE COMPRESSED GAS - Code W

Any material which will not burn when mixed with air in any proportion and which in addition, has an absolute pressure in the container exceeding 40 pounds psi at 70 degrees F or exceeding 104 pounds psi at 130 degrees F, or both.

#### OXIDIZING MATERIAL - Code J

Any substance such as chlorate, permanganate, peroxide or a nitrate that yields oxygen readily to stimulate the combustion of organic matter; or any material which readily furnishes oxygen for combustion and fire producers which react explosively or with evolution of heat in contact with many other materials.

#### POISON - Code P

Any substance or mixture of substances in any form that may be harmful or fatal when taken into the body orally in relatively small amounts; when inhaled; or when in continuous contact with the bare skin. Except when human experience indicates otherwise, laboratory determinations falling within any of the following categories apply:

VI

# Consolidated Hazardous Item List

## INTRODUCTION

### IDENTIFICATION

#### POISON (cont'd)

(1) Produces death within 14 days in half or more than half of a group of 10 or more laboratory white rats each weighing between 200 and 300 grams, at a single dose of 50 milligrams or less per kilogram of body weight, when orally administered; or when inhaled continuously for a period of one hour or less at an atmospheric concentration of 200 parts per million or less by volume of gas or vapor or 2 milligrams or less per liter of mist, fume or dust, provided such concentration is likely to be encountered by man when the substances are used in any reasonable foreseeable manner.

(2) Produces death within 14 days in half or more than half of a group of 10 or more rabbits tested in a dosage of 200 milligrams or less per kilogram of body weight, when administered by continuous contact with the bare skin for 24 hours or less.

#### RADIOACTIVE MATERIAL - Code R

Any material, combination of materials, or device which emits alpha, beta, gamma, and/or neutron (ionizing) radiation or which gives off dust, fumes, gases, and/or vapors emitting these radiations, and which has a level of activity within any of the following:

- (1) A specific activity greater than 0.002 microcuries per gram, or
- (2) A level of activity within the range specified for each radioactive isotope listed in Military Specification MIL-M-19590, or
- (3) A level of radioactivity greater than one tenth of one milliroentgen per hour (mr/hr) above background as determined by an end-window beta-gamma radiometer (AN/PDR-27 series or other instrument of equivalent sensitivity) held approximately one inch from the surface being surveyed.

#### RADIOACTIVE AND MAGNETIC MATERIAL - Code X

Any material, combination of materials or device which presents a combined hazard due to its magnetic and radioactive properties.

#### TOXIC SUBSTANCE - Code T

Any substance which has the inherent capacity to produce personal injury or illness to persons coming in contact with the substance or exposure to dangerous vapors, dust fume or mist given off by the substance through ingestion, inhalation or absorption through the body surface during utilization or processing.

VII

## Consolidated Hazardous Item List

## INTRODUCTION

## LABELING

## 1. Purpose.

The purpose of MIL-STD-755A labels is to warn users and handlers of the potential dangers involving the use of the material in the container, for each of the listed items. Materials to be labeled are those issued to the actual consumer (shop, office or unit). Label application includes the labeling of the original container and any other container to which the material may be subsequently transferred.

## 2. Labels.

HAZARDOUS CLASSIFICATION			
CLASS	LABEL	CLASS	LABEL
1	FIRE HAZARD	5	CORROSIVE
2	FIRE HAZARD AND TOXIC	6	RADIOACTIVE
3	TOXIC	7	FIRE HAZARD-OXIDIZER
4	POISONOUS		

## 3. General.

The MIL-STD-755A labels supplement labels/markings required under DOT (ICC) regulations for the identification of dangerous materials offered for shipment by common carrier, or any other label/markings applied by the MCA (Manufacturers Chemist Association), NEPA (National Fire Protective Association), and/or manufacturer. These supplemental labels shall not cover, or cause to deface or remove any other hazardous labels/markings affixed to the containers in accordance with the preceding regulations.

A hazardous item may be assigned two classes of labels dependent upon its composition/formulation. For example, an item, identified as corrosive and found to be poisonous, shall bear both a class 4 and class 5 label.

An illustration of each label, corresponding definition, and Cog I stock number is provided on pages IX and X.

VIII

## CONSOLIDATED HAZARDOUS ITEM LIST

## WARNING LABEL GUIDE

Class	Label	Description	Precaution	Label Size	Stock No. Cg 008
1		FIRE HAZARD (FLAMMABLE). Any material which is flammable or combustible.	Keep material away from body and clothing. Keep material away from sparks, heat, open flame. Observe "No Smoking" policy. Keep container closed, tightly sealed, and use properly. Store separately, away from other materials.	6 in. 5-1/2 in.	510-1000 510-1001
2		TOXIC AND FIRE HAZARD. Any material which is toxic or flammable (Class 1) and is toxic (Class 2).	Observe regulations above from Label 1 and Label 3.	6 in. 5-1/2 in.	510-1002 510-1003
3		TOXIC. Any material which may be harmful or dangerous in contact with the skin, eyes, nose, mouth, or lungs, or which may be absorbed through the skin, or which may cause other effects. The label must be affixed to the container after a toxic test has been performed, or after the body has been exposed to the material, or after the material has been tested for toxicity.	Keep material away from body and clothing. Avoid contact with skin, eyes, nose, mouth, or lungs. Avoid breathing vapors, dusts, or fumes. Wash hands before eating, drinking, or using toilet. Wash hands before eating, drinking, or using toilet. Keep container closed and away from heat.	6 in. 5-1/2 in.	510-1004 510-1005
4		POISONOUS. Any material which is harmful or dangerous when absorbed through the skin, or when inhaled, or when ingested, or when it comes in contact with the eyes, nose, mouth, or lungs.	Keep material away from body and clothing. Avoid contact with skin, eyes, nose, mouth, or lungs. Avoid breathing vapors, dusts, or fumes. Wash hands before eating, drinking, or using toilet. Wash hands before eating, drinking, or using toilet. Keep container closed and away from heat.	6 in. 5-1/2 in.	510-1006 510-1007

IX

## CONSOLIDATED HAZARDOUS ITEM LIST

## WARNING LABEL GUIDE

Chart	Label	Description	Precaution	Label Size	Stk No. 1 Eq QRM
5		Corrosive materials which upon contact with tissues of the body or surface will cause injury or destruction of tissue.	Avoid fumes, mists, and vapors of the material. Keep away from clothing. Wash off with plenty of water immediately after contact.	4 in. 2-1/2 in.	310-0100 310-0101
6		Radioactive materials which upon contact with tissues of the body or surface will cause injury or destruction of tissue.	Wash away contact immediately. Wash off with plenty of water. Avoid unnecessary handling. Report spills or breaks immediately.	4 in. 2-1/2 in.	310-0102 310-0103
7		Fire hazard - oxidizing materials which readily ignite or cause other materials to ignite. These materials may also cause fire or explosion when in contact with many other materials.	Store separately, away from flammable or combustible materials. Avoid oiling, if possible. Wash off with plenty of water.	4 in. 2-1/2 in.	310-0104 310-0105

## Consolidated Hazardous Item List

## INTRODUCTION

## STOWAGE

## 1. General.

Stowage requirements and special conditions specified herein are in accordance with those specified in NAVSHIPS Technical Manual 250-000, Chapter 9300, and related sections. In the event of differences in stowage requirements between NAVSHIPS Technical Manual and this publication, the requirements of the NAVSHIPS Technical Manual are to prevail.

## 2. Classification.

Shipboard stowage facilities for materials in portable containers are broadly described within the three classifications of material as Dangerous, Semisafe, and Safe. A fourth classification, identified as Restricted Dangerous Materials, serves to identify items which are not to be carried aboard ship. The classifications as employed in this publication provide for the following:

**Dangerous.** Applicable to materials which require isolated/specific stowage precautions/locations due to the high hazard of the material with respect to health, flammability, and/or reactivity. These materials are generally marked in accordance with the criteria for labeling/markings materials in the DOI system.

**Semisafe.** Primarily applicable to all combustible materials having a flash point, and which require special precaution/stowage requirements for ship safety. Although normally exempt from DOT labeling/markings, materials such as fuel oils, lubricating oils, greases, and waxes present a potential hazard to life and equipment when stowed aboard ships.

**Safe.** Applicable to materials which require no special precautions/stowage requirements in that they present a low hazard to health and no particular hazard due to combustibility and/or reactivity.

**Restricted Dangerous.** Applicable to those materials specifically not authorized for ships and/or nuclear powered submarine stowage. Certain items may be of a low degree of hazard but are restricted because of possible improper observance of precautions.

## Consolidated Hazardous Item List

## INTRODUCTION

## STOWAGE

## 3. Stowage Codes and Definitions.

Each of the items listed in this publication has been assigned a stowage code either in the broad classification of dangerous, semisafe, safe, and restricted dangerous or in the specific stowage condition for materials such as acids, alcohols, calcium carbide, calcium hypochlorite, compressed gases, gasoline, magnets and radioactive electron tubes or radials which present different and specific stowage problems. Stowage requirements for shipboard hazardous materials are classified and coded as:

CLASSIFICATION	STWG CODE
Acid	AC
Alcohol	AL
Calcium Carbide and Calcium Phosphide	CC
Calcium Hypochlorite and Bleaching Powder	CL
Compressed Gases	CG
Dangerous Materials	DM
Film (Nitrate Base)	NF
Gasoline	GA
Magnetic Materials	MM
Radioactive Materials	RM
Restricted Dangerous Materials	RD
Safe Materials	SM
Semisafe Materials	SD

## 4. Definitions.

## ACIDS - Code AC

Liquid acids, carried in glass containers, should be stowed in boxes, chests, or lockers lined with lead or other suitable acid resistant material. Exceptions are those items listed as safe materials (e.g. boric acid and oxalic acid). Compartments containing liquid acid should be located below the full-load waterline. The deck and lower part of the bulkheads are to be provided with a watertight lead lining. Medical acids must be stowed in lead-lined containers in the medical storeroom.

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## Consolidated Hazardous Item List

## INTRODUCTION

## STOWAGE

## ALCOHOL - Code AL

Alcohol must be stowed in a locker provided for the purpose within the paint and flammable liquid storeroom. It must not be carried elsewhere except as required for current operations. For medicinal purposes, alcohol and flammable liquids must be stowed in small containers in a double locker in the paint and flammable storeroom, except that a pint or quart container may be carried in the medical storeroom or pharmacy.

## CALCIUM CARBIDE AND CALCIUM PHOSPHIDE - Code CC

Calcium carbide and calcium phosphide must be stowed in a storeroom containing nonflammable stores and located so that there will be no danger of their being exposed to moisture. Weather deck stowage in watertight lockers is also considered satisfactory.

## CALCIUM HYPOCHLORITE AND BLEACHING POWDER - Code CL

Calcium hypochlorite and bleaching powder (chlorinated lime) must be stowed as follows:

- (1) Stow in a clean, cool, dry compartment or storeroom which is not adjacent to a magazine and is at a safe distance from any heat source. It must be located so that there will be no danger of exposure to moisture.
- (2) These materials are to be isolated from any flammable material or material which will support combustion. They are not to be stowed in the same compartment or storeroom with acids or other chemicals.

- (3) They may be stowed in a storeroom or other suitable space above the waterline, provided that conditions specified under (1) and (2) above are met. Weather deck stowage in watertight lockers is also considered satisfactory in this respect, provided that the other conditions specified above are met, and provided that the location is sheltered and protected from the direct rays of the sun.

Periodic inspections must be made to ensure that all stowed containers are tightly sealed and that exteriors of cans are free from corrosion. All defective containers must be removed from storage and either consumed by immediate use or otherwise disposed of.

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## Consolidated Hazardous Item List

## INTRODUCTION

STOWAGECOMPRESSED GASES - Code CG

In general, weather deck stowage will be provided for flammable and explosive gases. However, in specific cases, below deck stowage is approved depending on the particular type, mission, and arrangement of the vessel. In such cases, these approved locations are shown on the plans of the vessel. Compressed gases aboard all vessels, except cargo vessels, shall be stowed only in compartments designated by the Naval Command as shown in applicable plans for the vessel.

When compressed gas is stowed on the weather deck, precautions shall be observed not to stow oxygen and chlorine in close proximity to fuel gas cylinders. The stowage area must be protected against accumulation of snow/ice, and during summer screened from the direct rays of the sun. The stowage area shall be as remote as practical from navigation, fire control and gun stations. Other flammable materials, especially grease and oil, shall be kept out of the storage area.

When compressed gas is authorized for stowage in compartments, materials such as oxygen and chlorine shall be stowed away from flammable gases. Inert or nonflammable gases may be stowed in any compartment designated for compressed gas storage. Particular attention should be given to location of cylinder stowage to prevent fumes from leaking cylinders from entering ventilation air-intakes leading to spaces where personnel may be affected or flammable gases cause explosions.

Cylinders in actual use or attached to welding, fire fighting, medical refrigeration apparatus, etc., ready for use are permitted below decks outside of the stowage compartment. Fire extinguishers employing gases and fire extinguishing cylinders permanently connected to fixed fire extinguishing systems, as well as gases and chemical cannisters for oxygen-breathing apparatus, may be stowed in the vicinity in which they are to be used.

Though "empty" cylinders with valves securely closed and valve protection caps in place are comparatively less hazardous than full cylinders where stowage is concerned, empty cylinders shall be handled and stowed using the same precautions as for full cylinders. This is important since it is specified in NAVSHIPS Technical Manual 250-000 that cylinders of some gases are not to be completely exhausted but should be considered empty when the gas pressure falls to about 25 psi gage.

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## Consolidated Hazardous Item List

## INTRODUCTION

STOWAGEDANGEROUS MATERIALS, Not Elsewhere Specified - Code DM

This category includes those materials with considerable fire hazard or other dangerous characteristics not subject to specific stowage requirements. It encompasses all DOT and ICC classified and labeled material not elsewhere specified. Excluded from consideration because of their special stowage requirements are materials such as dangerous acids, alcohol, calcium carbide, calcium phosphide, calcium hypochlorite (chlorinated lime), compressed gases, nitrate-based film, gasoline, and radioactive materials. Dangerous Materials under this code may be categorized as follows:

- (1) All flammable liquids, except as otherwise allowed herein, must be stowed in the paint and flammable liquids storerooms. Liquids placed in this storeroom are preferably stowed in five gallon containers.
- (2) Except as otherwise allowed herein, extremely flammable liquid stowage shall follow the requirements set forth for flammable liquids.
- (3) All other dangerous materials, not elsewhere specified, such as corrosive liquids (alkaline), flammable solids, oxidizing materials, and poisons should have isolated stowage from other dangerous materials and from each other, especially powerful oxidizing materials and low combustible materials. For instance ordinary glycerol and potassium permanganate, when simply blended at room temperature for a few minutes, react violently to produce a hot fire.

GASOLINE - Code GA

Except when specifically authorized to the contrary, gasoline carried in drums or cases as cargo shall be stowed on the weather deck, well clear of the galleys and heated spaces and arranged so that they may be readily thrown overboard.

On vessels where gasoline in drums or cases is authorized to be carried as cargo in holds or between decks, it shall be stowed in a hold separated by oil-tight steel structure from all other cargo, with direct access to the weather deck, and not adjacent to boiler or machinery spaces and uptakes. The drums shall be well secured, utilizing wood dunnage, to prevent movement that might cause sparks or rupture of drums. The greatest care should be taken to see that only tight containers are stowed.

## Consolidated Hazardous Item List

### INTRODUCTION

#### STOWAGE

#### GASOLINE (cont'd)

Gasoline when carried in cans for ship's own use shall be stowed in the paint and flammable liquids storeroom. When two such storerooms are provided, the total quantity shall be equally divided. In vessels having no flammable liquid storeroom, gasoline shall be carried in drums or cans on the weather deck and so located and stowed that the containers may be readily thrown overboard. Weather deck storage shall not be in the vicinity of hatches, galleys, heat-producing spaces, ventilation inlets or exhausts from such spaces, ready service magazines, in or close to the line of fire of guns. Whenever practical, subject to the foregoing, weather deck stowage shall be near the stern of the vessel. Quick release type racks, where fitted, should be inspected frequently to ensure proper functioning.

On vessels having not more than four P-250 emergency fire pumps, one of the two 7-1/2 gallon containers furnished with each unit shall be filled with fuel mixture and stowed in a rack adjacent to each pump. On vessels provided with more than four P-250 pumps, the quantity shall be increased on the basis of one 7-1/2 gallon filled container for each two additional pumps.

The permanently attached tanks for all portable pumps such as the handability pump shall be kept filled with fuel mixture.

#### MAGNETIC MATERIALS - Code MM

Magnets and magnetrons require strict compliance with handling and stowage precautions in order to prevent damage to magnetically sensitive instruments.

#### NITRATE BASE FILM - Code NF

Small quantities of 16mm and 35mm motion picture film of the nitrate-base type may be stored in the training aide lockers. Large quantities are stowed in a storeroom protected by sprinkling or in the paint and flammable liquids storeroom.

#### RADIOACTIVE MATERIALS - Code RM

Radiation sources contained in separately packaged units are to a certain extent additive. Therefore the items shall be stored as far away from personnel as feasible. Storage shall be arranged to orient any concentrated location of the radiation source within a container surface at a maximum distance from other concentrated surfaces in the storage location.

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## Consolidated Hazardous Item List

### INTRODUCTION

#### STOWAGE

#### RADIOACTIVE MATERIALS (cont'd)

Areas where radioactive material is stored will be conspicuously marked and entry to the area restricted in accordance with current instructions, directives and regulations in effect. (Extract from ESOSINST 5100.3 and FASOSINST 4450-11).

#### RESTRICTED DANGEROUS MATERIALS - Code RD

Certain materials by nature are not suitable for shipboard usage or stowage. These may be restricted from all ships or one or more type of ships. For example:

(1) Materials such as benzene (benzol), carbon tetrachloride, DDT Xylene emulsion, hydrocyanic acid gas, and methyl bromide are not to be stored aboard any ship.

(2) Materials such as steel wool and mercury batteries are not to be stowed aboard submarines.

#### SAFE MATERIALS - Code SM

Materials considered safe in that they are not subject to spontaneous combustion and present no particular hazard due to reactions which might arise from broken containers.

#### SEMI-SAFE MATERIALS - Code SD

Materials which are considered safe as long as contained in unopened, nonleaking containers, it being understood that in the event of leakage, any spilled material would be cleaned up with reasonable promptness and the leaking containers disposed of. Applicable to all material not DOT classified for affixing of labels, but which are considered hazardous within the Naval Supply System.

Except as otherwise specified, all combustible materials classified as semisafe must be stowed in the paint and flammable liquids storerooms. Whenever practical, storerooms are located below the full load waterline, near either end of the vessel, not adjacent to a magazine.

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**Consolidated Hazardous Item List****INTRODUCTION****SECTION "D" FORMAT**

Section D indicates the history of hazardous items that have been deleted, superseded or reclassified as a result of change actions taken subsequent to the first publication. Each page contains three columns of data with the following information:

**FSC** - The Federal Supply Class of the item

**FIIN** - The Federal Item Identification Number of the item

**HZRD** - The hazardous code assigned to the item at the time it was deleted, superseded or reclassified.

**ACTION** - The action that altered the initial designation of the item. This action is noted by the following phrases:

**DELETED** - Item is no longer an active item of supply.

**TRANS TO** - Item has been replaced by another item. Hazardous data for the new item are listed in Sections A, and B.

**RECLASS** - Item has been reclassified as nonhazardous.

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**Consolidated Hazardous Item List****INTRODUCTION****MAINTENANCE**

The CHIL will be republished when 25% of the line item data has been subjected to change actions, or republished annually, whichever comes first.

The CHIL will be updated by FMSC Change Notices, as required. Item actions therein will be incorporated in the subsequent republication of the CHIL.

**DISTRIBUTION**

Initial distribution of the CHIL is made to all holders of the NMML (Navy Management Data List) in the same number of copies. New requests or changes in the number of copies required (increase/decrease) are to be submitted as follows:

**AFLCANT**

To the Commanding Officer, Navy Fleet Material Support Office, Code 943, Mechanicsburg, Pa. 17055 via the appropriate Type Commander.

**ASHORE**

To the Commanding Officer, Navy Fleet Material Support Office, Code 943, Mechanicsburg, Pa. 17055.

**COAST GUARD UNITS**

To the U.S. Coast Guard Headquarters, 1300 "E" Street, N.W., Washington, D.C. 20591 for approval.

**INVITATIONS FOR COMMENTS, SUGGESTIONS AND CORRECTIONS**

Comments, recommendations and corrections pertaining to information contained in this publication should be directed to the Commanding Officer, Navy Fleet Material Support Office, Code 943, Mechanicsburg, Pa. 17055.

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## Consolidated Hazardous Item List

NOMENCLATURE					HZ	RD	LABEL	ST	WG	NOMENCLATURE					HZ	RD	LABEL	ST	WG														
ABC WASHDOWN /CARBON PRODUCTS										S	2	ADHESIVE /LIQUID CEMENT										1A	8040	821-4112	MX	F	1	DM					
ACCELERATOR DDM /LUPERSOL-LUCIDOL										H	5	7	ADHESIVE /LIQUID CEMENT										1R	8040	821-4121	DA	F	1	DM				
ACETIC ACID, GLACIAL										9G	6750	141-6558	S	2	5	SD	ADHESIVE /LIQUID CEMENT										9Q	8040	839-4919	F	2	DM	
ACETIC ACID, GLACIAL										9G	6810	222-2634	S	2	5	SD	ADHESIVE /LIQUID CEMENT										9Q	8040	855-0821	GX	F	2	DM
ACETIC ACID, GLACIAL										9G	6810	275-1215	S	2	5	SD																	
ACETONE										9G	6810	184-4796	Q	2		DM	ADHESIVE /LIQUID CEMENT										9Z	8040	878-9231	F	2	DM	
ACETONE										9G	6810	223-2739	Q	2		DM	ADHESIVE /LIQUID CEMENT										9Q	8040	887-1893	F	2	DM	
ACETONE										9G	6810	264-8955	Q	2		DM	ADHESIVE /LIQUID CEMENT										1R	8040	965-6671	GX	F	2	DM
ACETONE										9G	6810	281-1864	Q	2		DM	ADHESIVE /LIQUID CEMENT										9Q	8040	970-1506	F	2	DM	
ACETYLENE										9G	6830	264-6751	B	2		CG	ADHESIVE /LIQUID CEMENT										9Q	8040	970-1531	F	2	DM	
ACETYLENE										9Q	6830	264-6755	B	2		CG	ADHESIVE /LIQUID CEMENT										9Q	8040	984-1041	F	2	DM	
ACETYLENE										9Q	6830	270-8216	B	2		CG	ADHESIVE /LIQUID CEMENT										9Q	8040	995-4153	F	2	DM	
ACETYLENE										9Q	6830	286-5434	B	2		CG	ADHESIVE /RUBBER CEMENT										9Q	8040	024-9628	F	2	DM	
ACETYLENE										9Q	6830	290-4293	B	2		CG	ADHESIVE /RUBBER CEMENT										1H	8040	051-1317	F	2	DM	
ACETYLENE										9Q	6830	290-4370	B	2		CG	ADHESIVE /RUBBER CEMENT										1H	8040	051-1318	F	2	DM	
ACETYLENE										9G	6830	290-4371	B	2		CG	ADHESIVE /RUBBER CEMENT										9Q	8040	165-8614	F	2	DM	
ACETYLENE PURIFIER CPD										9G	6850	264-6759	M	3	5	SM	ADHESIVE /RUBBER CEMENT										9Q	8040	200-4574	F	2	DM	
ACETYLENE PURIFIER CPD /LINDE CO.										M	3	5					ADHESIVE /RUBBER CEMENT										9Q	8040	262-9011	Q	2	DM	
ACME CHLORDANE 72PCT /ACME PAINTS										S	2						ADHESIVE /RUBBER CEMENT										9Q	8040	262-9031	Q	2	DM	
ACRYLIC COATING MIL-C-12599 /TRID										S	2						ADHESIVE /RUBBER CEMENT										9Q	8040	262-9060	F	2	DM	
ACTIVATOR 8 /DUPONT										I	3						ADHESIVE /RUBBER CEMENT										9Q	8040	266-0824	F	2	DM	
ACTIVATOR, ADHESIVE										9Q	8040	663-2495	S	2		SD	ADHESIVE /RUBBER CEMENT										9Q	8040	266-0853	F	2	DM	
ACTIVATOR, ADHESIVE										9Q	8030	739-9142	S	2		SD	ADHESIVE /RUBBER CEMENT										9Q	8040	266-0855	F	2	DM	
ACTIVATOR, PRIMER										9Q	8030	980-3875	F	1		DM	ADHESIVE /RUBBER CEMENT										9Q	8040	266-0856	F	2	DM	
ACTIVATOR, PRIMER										9Q	8030	980-3876	F	1		DM	ADHESIVE /RUBBER CEMENT										9Q	8040	266-7422	F	2	DM	
ADHESIVE										9Q	8040	225-4548	I	3		SM	ADHESIVE /RUBBER CEMENT										9Q	8040	266-7427	F	2	DM	
ADHESIVE										9Q	8040	262-9028	S	2		SD	ADHESIVE /RUBBER CEMENT										9Q	8040	273-8697	Q	2	DM	
ADHESIVE										9Q	8040	761-8994	S	2		SD	ADHESIVE /RUBBER CEMENT										9Q	8040	273-8716	F	2	DM	
ADHESIVE /LIQUID CEMENT										1H	8040	070-9510	F	2		DM	ADHESIVE /RUBBER CEMENT										9Q	8040	273-8717	F	2	DM	
ADHESIVE /LIQUID CEMENT										1H	8040	070-9522	F	2		DM	ADHESIVE /RUBBER CEMENT										9Q	8040	281-8199	F	2	DM	
ADHESIVE /LIQUID CEMENT										1H	8040	072-5035	F	2		DM	ADHESIVE /RUBBER CEMENT										9Q	8040	285-1572	F	2	DM	
ADHESIVE /LIQUID CEMENT										9Q	8040	010-6622	F	2		DM	ADHESIVE /RUBBER CEMENT										9Q	8040	290-4301	Q	2	DM	
ADHESIVE /LIQUID CEMENT										9Q	8040	016-3007	F	2		DM	ADHESIVE /RUBBER CEMENT										9Q	8040	290-7113	F	2	DM	
ADHESIVE /LIQUID CEMENT										9Q	8040	078-8825	F	2		DM	ADHESIVE /RUBBER CEMENT										9Q	8040	291-8381	F	2	DM	
ADHESIVE /LIQUID CEMENT										9Q	8040	083-6872	F	2		DM	ADHESIVE /RUBBER CEMENT										9Q	8040	319-0100	F	2	DM	
ADHESIVE /LIQUID CEMENT										9Q	8040	200-3793	F	2		DM	ADHESIVE /RUBBER CEMENT										9Q	8040	390-7960	F	2	DM	
ADHESIVE /LIQUID CEMENT										9Q	8040	221-3811	Q	2		DM	ADHESIVE /RUBBER CEMENT										9Q	8040	390-7963	F	2	DM	
ADHESIVE /LIQUID CEMENT										9Q	8040	221-3813	F	2		DM	ADHESIVE /RUBBER CEMENT										9Q	8040	390-7964	F	2	DM	
ADHESIVE /LIQUID CEMENT										9Q	8040	270-8150	F	2		DM	ADHESIVE /RUBBER CEMENT										9Q	8040	433-4065	F	2	DM	
ADHESIVE /LIQUID CEMENT										9Q	8040	291-8625	F	2		DM	ADHESIVE /RUBBER CEMENT										9Q	8040	514-1880	F	2	DM	
ADHESIVE /LIQUID CEMENT										9Q	8040	319-1878	F	1		DM	ADHESIVE /RUBBER CEMENT										9Q	8040	545-0339	F	2	DM	
ADHESIVE /LIQUID CEMENT										9Q	8040	444-8732	F	2		DM	ADHESIVE /RUBBER CEMENT										9Q	8040	515-1727	F	2	DM	
ADHESIVE /LIQUID CEMENT										9Q	8040	522-4309	F	2		DM	ADHESIVE /RUBBER CEMENT										9Q	8040	515-1731	F	2	DM	
ADHESIVE /LIQUID CEMENT										9Q	8040	530-4820	F	2		DM	ADHESIVE /RUBBER CEMENT										9Q	8040	515-2246	F	2	DM	
ADHESIVE /LIQUID CEMENT										9Q	8040	532-7270	F	2		DM	ADHESIVE /RUBBER CEMENT										9Q	8040	515-2250	F	2	DM	
ADHESIVE /LIQUID CEMENT										9Q	8040	550-8835	Q	2		DM	ADHESIVE /RUBBER CEMENT										9Q	8040	522-4312	F	2	DM	
ADHESIVE /LIQUID CEMENT										9Q	8040	550-8836	F	1		DM	ADHESIVE /RUBBER CEMENT										9Q	8040	543-7170	F	2	DM	
ADHESIVE /LIQUID CEMENT										9Q	8040	550-8837	F	1		DM	ADHESIVE /RUBBER CEMENT										9Q	8040	548-2403	F	2	DM	
ADHESIVE /LIQUID CEMENT										9Q	8040	562-7944	F	2		DM	ADHESIVE /RUBBER CEMENT										9Q	8040	584-3722	F	2	DM	
ADHESIVE /LIQUID CEMENT										9Q	8040	573-1502	F	2		DM	ADHESIVE /RUBBER CEMENT										9Q	8040	598-4510	F	2	DM	
ADHESIVE /LIQUID CEMENT										9Q	8040	576-1781	F	2		DM	ADHESIVE /RUBBER CEMENT										9Q	8040	598-6923	F	2	DM	
ADHESIVE /LIQUID CEMENT										9Q	8040	576-2014	F	2		DM	ADHESIVE /RUBBER CEMENT										1H	8040	644-1415	F	2	DM	
ADHESIVE /LIQUID CEMENT										9Q	8040	577-4610	F	2		DM	ADHESIVE /RUBBER CEMENT										9Q	8040	644-1703	F	2	DM	
ADHESIVE /LIQUID CEMENT										9Q	8040	598-9743	F	2		DM	ADHESIVE /RUBBER CEMENT										9Q	8040	644-4318	Q	2	DM	
ADHESIVE /LIQUID CEMENT										9Q	8040	598-9746	F	2		DM	ADHESIVE /RUBBER CEMENT										9Q	8040	717-1750	F	2	DM	
ADHESIVE /LIQUID CEMENT										9Q	8040	606-3549	F	2		DM	ADHESIVE /RUBBER CEMENT										9Q	8040	717-2816	F	2	DM	
ADHESIVE /LIQUID CEMENT										9Q	8040	642-8752	F	2		DM	ADHESIVE /RUBBER CEMENT										9Q	8040	717-2818	F	2	DM	
ADHESIVE /LIQUID CEMENT										9Q	8040	643-8875	F	2		DM	ADHESIVE /RUBBER CEMENT										9Q	8040	727-0706	F	2	DM	
ADHESIVE /LIQUID CEMENT										9Q	8040	644-0439	F	2		DM	ADHESIVE /RUBBER CEMENT										9Q	8040	727-1367	F	2	DM	
ADHESIVE /LIQUID CEMENT										9Q	8040	717-2811	F	2		DM	ADHESIVE /RUBBER CEMENT										9Q	8040	727-1369	F	2	DM	
ADHESIVE /LIQUID CEMENT										9Q	8040	727-1368	F	2		DM	ADHESIVE /RUBBER CEMENT										9Q	8040	727-1370	F	2	DM	
ADHESIVE /LIQUID CEMENT										9Q	8040	734-2485	F	2		DM	ADHESIVE /RUBBER CEMENT										9Q	8040	820-3245	F	2	DM	
ADHESIVE /LIQUID CEMENT										9Q	8040	734-2685	F	2		DM	ADHESIVE /RUBBER CEMENT										9Q	8040	843-9460	F	2	DM	
ADHESIVE /LIQUID CEMENT										9Q	8040	769-3894	F	2		DM	ADHESIVE /RUBBER CEMENT										9Q	8040	850-4182	F	2	DM	

# Consolidated Hazardous Item List

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Consolidated Harvard Item List

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# Consolidated Hazardous Waste List

[illegible]

# Consolidated Hazardous Waste

[illegible]

Consolidated Hazardous Waste Item 1511

[illegible]

price 1.00

### Consolidated Hazardous Item List

[illegible]

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## Consolidated Hazardous Item List

ITEM NO	DESCRIPTION	QTY	UNIT	Hazardous	Level
10001	10001	1	EA	Y	1
10002	10002	1	EA	Y	1
10003	10003	1	EA	Y	1
10004	10004	1	EA	Y	1
10005	10005	1	EA	Y	1
10006	10006	1	EA	Y	1
10007	10007	1	EA	Y	1
10008	10008	1	EA	Y	1
10009	10009	1	EA	Y	1
10010	10010	1	EA	Y	1
10011	10011	1	EA	Y	1
10012	10012	1	EA	Y	1
10013	10013	1	EA	Y	1
10014	10014	1	EA	Y	1
10015	10015	1	EA	Y	1
10016	10016	1	EA	Y	1
10017	10017	1	EA	Y	1
10018	10018	1	EA	Y	1
10019	10019	1	EA	Y	1
10020	10020	1	EA	Y	1
10021	10021	1	EA	Y	1
10022	10022	1	EA	Y	1
10023	10023	1	EA	Y	1
10024	10024	1	EA	Y	1
10025	10025	1	EA	Y	1
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10097	10097	1	EA	Y	1
10098	10098	1	EA	Y	1
10099	10099	1	EA	Y	1
10100	10100	1	EA	Y	1

## Consolidated Hazardous Item List

ITEM NO	DESCRIPTION	QTY	UNIT	Hazardous	Level
10101	10101	1	EA	Y	1
10102	10102	1	EA	Y	1
10103	10103	1	EA	Y	1
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10197	10197	1	EA	Y	1
10198	10198	1	EA	Y	1
10199	10199	1	EA	Y	1
10200	10200	1	EA	Y	1

11-4-2010

11-4-2010

**Consolidated**

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41-3572

Consolidated Wet Storage

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## Consolidated Hazardous Item List

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## Consolidated Hazardous Item List

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**Consolidated Hazardous Item List**

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1517 MAIL SAOPHORN PATAPLISOBOJ

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**1st Natl Soapstone Pipeline**

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1517 mail stopazn potnplismo

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EC-1374

**Consolidated Hazardous Waste**

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44-38861-1000

## Consolidated Hazardous Item List

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WIFE M- 93

### Consolidated Hazards from List

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## Consolidated Hazardous Item List

NAME	DATE	REMARKS	STATUS
ALLEN, JAMES	10/10/50	RECEIVED	OK
BROWN, JOHN	10/10/50	RECEIVED	OK
SMITH, JAMES	10/10/50	RECEIVED	OK
WILLIAMS, JAMES	10/10/50	RECEIVED	OK
JOHNSON, JAMES	10/10/50	RECEIVED	OK
DAVIS, JAMES	10/10/50	RECEIVED	OK
WILSON, JAMES	10/10/50	RECEIVED	OK
ANDERSON, JAMES	10/10/50	RECEIVED	OK
THOMAS, JAMES	10/10/50	RECEIVED	OK
LEE, JAMES	10/10/50	RECEIVED	OK
WALKER, JAMES	10/10/50	RECEIVED	OK
YOUNG, JAMES	10/10/50	RECEIVED	OK
EVANS, JAMES	10/10/50	RECEIVED	OK
ROBERTS, JAMES	10/10/50	RECEIVED	OK
TURNER, JAMES	10/10/50	RECEIVED	OK
PHILLIPS, JAMES	10/10/50	RECEIVED	OK
CAMPBELL, JAMES	10/10/50	RECEIVED	OK
COOPER, JAMES	10/10/50	RECEIVED	OK
BAKER, JAMES	10/10/50	RECEIVED	OK
GREEN, JAMES	10/10/50	RECEIVED	OK
MARTIN, JAMES	10/10/50	RECEIVED	OK
PERKINS, JAMES	10/10/50	RECEIVED	OK
LONG, JAMES	10/10/50	RECEIVED	OK
HARRIS, JAMES	10/10/50	RECEIVED	OK
WATSON, JAMES	10/10/50	RECEIVED	OK
BRYAN, JAMES	10/10/50	RECEIVED	OK
CHAMBERS, JAMES	10/10/50	RECEIVED	OK
SWANSON, JAMES	10/10/50	RECEIVED	OK
WHEATON, JAMES	10/10/50	RECEIVED	OK
WILLIAMS, JAMES	10/10/50	RECEIVED	OK
ANDERSON, JAMES	10/10/50	RECEIVED	OK
THOMAS, JAMES	10/10/50	RECEIVED	OK
LEE, JAMES	10/10/50	RECEIVED	OK
WALKER, JAMES	10/10/50	RECEIVED	OK
YOUNG, JAMES	10/10/50	RECEIVED	OK
EVANS, JAMES	10/10/50	RECEIVED	OK
ROBERTS, JAMES	10/10/50	RECEIVED	OK
TURNER, JAMES			

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# Consolidated Hazardous Waste List

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## Consolidated Hazardous Item List

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# Consolidated Hazardous Waste List

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**Consolidated Hazardous Waste**

FIELD NUMBER/ISSUES /INVENTORIES /PAGES /REMARKS/REMARKS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	542	543	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561	562	563	564	565	566	567	568	569	570	571	572	573	574	575	576	577	578	579	580	581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600	601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620	621	622	623	624	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639	640	641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656	657	658	659	660	661	662	663	664	665	666	667	668	669	670	671	672	673	674	675	676	677	678	679	680	681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699	700	701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720	721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739	740	741	742	743	744	745	746	747	748	749	750	751	752	753	754	755	756	757	758	759	760	761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776	777	778	779	780	781	782	783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800	801	802	803	804	805	806	807	808	809	810	811	812	813	814	815	816	817	818	819	820	821	822	823	824	825	826	827	828	829	830	831	832	833	834	835	836	837	838	839	840	841	842	843	844	845	846	847	848	849	850	851	852	853	854	855	856	857	858	859	860	861	862	863	864	865	866	867	868	869	870	871	872	873	874	875	876	877	878	879	880	881	882	883	884	885	886	887	888	889	890	891	892	893	894	895	896	897	898	899	900	901	902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918	919	920	921	922	923	924	925	926	927	928	929	930	931	932	933	934	935	936	937	938	939	940	941	942	943	944	945	946	947	948	949	950	951	952	953	954	955	956	957	958	959	960	961	962	963	964	965	966	967	968	969	970	971	972	973	974	975	976	977	978	979	980	981	982	983	984	985	986	987	988	989	990	991	992	993	994	995	996	997	998	999	1000	1001	1002	1003	1004	1005	1006	1007	1008	1009	1010	1011	1012	1013	1014	1015	1016	1017	1018	1019	1020	1021	1022	1023	1024	1025	1026	1027	1028	1029	1030	1031	1032	1033	1034	1035	1036	1037	1038	1039	1040	1041	1042	1043	1044	1045	1046	1047	1048	1049	1050	1051	1052	1053	1054	1055	1056	1057	1058	1059	1060	1061	1062	1063	1064	1065	1066	1067	1068	1069	1070	1071	1072	1073	1074	1075	1076	1077	1078	1079	1080	1081	1082	1083	1084	1085	1086	1087	1088	1089	1090	1091	1092	1093	1094	1095	1096	1097	1098	1099	1100	1101	1102	1103	1104	1105	1106	1107	1108	1109	1110	1111	1112	1113	1114	1115	1116	1117	1118	1119	1120	1121	1122	1123	1124	1125	1126	1127	1128	1129	1130	1131	1132	1133	1134	1135	1136	1137	1138	1139	1140	1141	1142	1143	1144	1145	1146	1147	1148	1149	1150	1151	1152	1153	1154	1155	1156	1157	1158	1159	1160	1161	1162	1163	1164	1165	1166	1167	1168	1169	1170	1171	1172	1173	1174	1175	1176	1177	1178	1179	1180	1181	1182	1183	1184	1185	1186	1187	1188	1189	1190	1191	1192	1193	1194	1195	1196	1197	1198	1199	1200	1201	1202	1203	1204	1205	1206	1207	1208	1209	1210	1211	1212	1213	1214	1215	1216	1217	1218	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# NOTES

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# **Exhibit 27**

POST AUDIT COPY

Number, Date, Superseding Data  
and Interest  
Essential Comments Included  
Figures returned  
Fluorprint pencils returned

MIL-M-15071D(SHIPS)  
6 June 1961  
SUPERSEDING  
MIL-M-15071C(SHIPS)  
10 September 1957

MCC 8/29/61 MILITARY SPECIFICATION  
(Revised) MANUAL, SERVICE (INSTRUCTION BOOKS) FOR SHIPBOARD  
ELECTRICAL AND MECHANICAL EQUIPMENT

## 1. SCOPE

1.1 Scope. - This specification sets forth Bureau of Ships requirements for classes and general contents of manuals necessary for the satisfactory operation, maintenance, installation, overhaul and repair, without the services of manufacturer's representative, of electrical, mechanical, hull, interior communication and fire control shipboard equipment. This specification also includes procedures for submission, review, approval and revision of the service manual. The intent is to accept the manufacturer's commercial type of manual or one prepared in accordance with his commercial practice whenever it is roughly equivalent to the detail requirements included herein.

1.2 Classification. - Service manuals shall be of the following classes:

Class A manual - A basic manual covering a family of equipment of the same basic design and one which can be made applicable to a specific equipment manufactured to that basic design by completing sheets and blanks.  
Class B manual - A manual covering a specific equipment for which a class A approval has not been obtained.

## 2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issue in effect on date of invitation for bids, form a part of this specification to the extent specified herein.

## SPECIFICATIONS

## MILITARY

MIL-D-963 - Drawing, Electrical, Hull and Mechanical Equipment for Naval Shipboard Use.

## PUBLICATIONS

## DEPARTMENT OF DEFENSE

DD Form 441 (Attachment) - Industrial Security Manual for Safe-guarding Classified Information.

Recorded	7/25/61
Board Cleared	
Coordinator	
File	

(Copies of specifications and publications required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 The following document forms a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids shall apply.

OFFICIAL CLASSIFICATION COMMITTEE  
Uniform Freight Classification Rules.

(Application for copies should be addressed to the Official Classification Committee, 1 Park Avenue at 33rd Street, New York 16, N. Y.)

## 3. REQUIREMENTS

3.1 Media for final manuals and approval. -

3.1.1 Class A manuals. - Whenever a manufacturer's equipment lends itself to the preparation of a manual covering a family of equipments of the same basic design and one which can be made applicable to specific equipments of that design by completing sheets and blanks, the manufacturer may submit to the Bureau of Ships four copies of the basic manual together with examples of the sheets and blanks which will represent the detailed information to be provided for a specific equipment. Approval of a class A manual will be by the Bureau of Ships only and, once approved, the basic manual shall not be modified without the approval of the Bureau of Ships. At the time of class A manual approval, the Bureau will assign a NAVSHIPS number to the basic manual and forward one copy to the cognizant inspector for future comparison inspection with manuals furnished for specific equipments.

3.1.1.1 Once approval of a class A manual is granted for a particular basic design of equipment (and size range, if appropriate), the basic manual with the specific detailed information required for the unit of the family being furnished on a contract or order may be supplied by the manufacturer, in the quantities required by that order, without further approval. Copies of the manual prepared for the specific equipments shall be marked by the manufacturer with the NAVSHIPS number of the basic

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manual followed by "-1", "-2" or higher. Each dash number shall be assigned numerically by the manufacturer for each specific equipment of that family.

**3.1.2 Class B manuals.** - Class B manuals cover a specific equipment for which class A approval has not been obtained. Once a class B manual has been approved by the Bureau or its field representative, the manual shall not be modified without approval of the Bureau of Ships. (NOTE: Bureau of Ships field representative - Where the term "field representative" is used in this specification, it is limited to field representative of the Bureau of Ships, i.e. Supervisors of Shipbuilding, USN, U.S. Naval Shipyards and Industrial Manager, USN.) Whenever a manual for a specific equipment has not been approved previously, for this or a previous issue of this specification, prior to preparing final manuals, the manufacturer shall prepare and submit a sample manual for approval to one of the following activities, as appropriate:

- (a) Manuals procured on Bureau of Ships contracts - Contractor shall forward four sample copies to the Bureau of Ships for approval and assignment of a NAVSHIPS number with a copy of the forwarding document to the cognizant Government inspector.
- (b) Manuals procured on contracts issued by Naval activities other than Bureau of Ships - Contractor shall forward four sample copies to the Naval activity for approval.
- (c) Manuals procured for the Navy by a commercial activity (such as a private shipbuilder) - Contractor shall forward five sample copies to the commercial activity for approval of both the commercial activity and the cognizant Bureau representative.

**3.1.2.1** The Bureau will assign a NAVSHIPS number to each different class B manual as follows:

- (a) Manuals procured on contracts issued by the Bureau of Ships - The NAVSHIPS number will be included in the approval letter.
- (b) Manuals procured on contracts issued by other activities.

The field approving activities may obtain NAVSHIPS numbers from the Bureau of Ships by one of the following methods:

- (a) Submit two copies of the manual prior or subsequent to the review and approval.
- (b) Permit the manufacturer to forward two copies of the manual to the Bureau simultaneously with the copies for approval.

- (c) In urgent cases, submit a letter containing the nameplate data of the equipment, the ship applicability and contract or order number.

**3.1.2.2** Regardless of the method used for obtaining NAVSHIPS numbers, the letter request shall state the expected delivery date of the manuals and the quantity of manuals being furnished for stock.

**3.1.3 Emphasis.** - The bureau of Ships is mainly interested in the adequacy and completeness of contents and the clarity and readability of the information rather than the format. The manual shall be oriented toward operation, maintenance and repair of the equipment by the forces afloat, without the services of a manufacturer's representative. The portions devoted to descriptive matter and theory shall be limited to those which are essential to a proper understanding of the equipment for satisfactory operation, maintenance and repair. The text need not duplicate information which is adequately shown on the photographs, drawings and illustrations incorporated in the manual. (A class A or B manual may be the manufacturer's commercial manual, or one prepared in accordance with his commercial practice whenever it will be suitable for the service intended as determined by the approving activity.)

**3.1.4 Security classification.** - The security classification of manuals shall be as designated by the bureau or agency concerned. If classified, the security guide issued by DD form 254, forming a part of the contract shall be followed. All pages shall be marked in accordance with the requirements of the Industrial Security Manual for Safeguarding Classified Information (DD 441 (Attachment)). Where a minor amount of classified information is involved, two volumes - one unclassified and one classified shall be provided. The word "UNCLASSIFIED" need not appear on each page of unclassified portions of classified manuals. Revisions shall be classified as required by their subject matter. Regardless of the overall classification of a classified publication, an unclassified title shall be assigned whenever possible and consistent with security and clarity. In all cases, however, if a classified manual is involved, the initials of the classification assigned to the title, standing alone, shall be indicated in parentheses immediately following the title, using one of the following notation (U), (C), (S), (TS). In addition, the covers of classified manuals shall include the markings as indicated on figure 1.

### 3.1.5 Detail requirements.

**3.1.5.1 Contents.** - Manuals shall contain the following information, arranged in an order appropriate to provide adequate instruction for operation

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and maintenance of each unit in the equipment and the complete assembly: No particular arrangement, format or chapter titles are required as long as the information is suitably presented.

Front Matter  
General Information  
Installation  
Principles of Operation  
Operating Instructions  
Maintenance and Repair  
Parts Lists

3.1.5.2 Front matter. - The front matter shall consist of the following:

- (a) Cover
- (b) Title page (for classified manuals only)
- (c) Approval and procurement record page
- (d) List of effective pages
- (e) Table of contents
- (f) List of figures
- (g) List of tables

3.1.5.2.1 Cover and title page. - The cover shall contain the information on figure 1. The title page for classified manuals shall conform to figure 2.

3.1.5.2.2 Approval and procurement record page. - The approval and procurement record (APR) page shall be the first page of unclassified manuals and shall follow the title page of classified manuals and shall conform to figure 3.

3.1.5.2.3 List of effective pages. - A list of effective pages shall be included. In multiple volume manuals, the list of effective pages shall be included in volume 1 only. The list of effective pages shall be modified whenever revisions are incorporated in copies of the manual.

3.1.5.2.4 Table of contents. - The table of contents shall list all primary divisions and secondary subdivisions such as chapters, sections and pages with their corresponding numbers. Where sub-manufacturers are furnishing associated equipment and a separate manual is not provided, it shall be the responsibility of the prime contractor to integrate and reflect the information provided by the sub-manufacturers within the table of contents. In multiple volume publications, a table of contents shall be prepared for each volume.

3.1.5.2.5 List of figures. - A list of figures shall be prepared listing all figures, their titles and numbers. In multi-volume publications, a list of figures shall be prepared for each volume.

3.1.5.2.6 List of tables. - A list of tables shall be prepared listing all tables, their titles and

numbers. In multi-volume publications, a list of tables shall be prepared for each volume.

3.1.6 General information. - General information shall consist of general data, a general description and detailed descriptions, as necessary to supplement data included in drawings and photographs.

3.1.6.1 General data. - General data shall consist of the following data for each component or unit:

- (a) Descriptive (name plate) data necessary to identify manufacturer, type, model and performance or design characteristics.
- (b) Principal overall dimensions.
- (c) Weight.
- (d) Allowable capacities, temperatures, pressures, settings, tolerances or other salient features as appropriate to the item shall be shown.

3.1.6.2 General description. - General description shall consist of a short general description of the equipment; explain briefly what it is, what it will do, and the general overall and interrelated operation of the various units. All information of a general character applicable to the complete equipment shall also be given. Where the text contains terms or symbols not commonly used, definitions or explanatory notes shall be included.

3.1.6.3 Detailed description. - Detailed description shall contain a complete detailed description of units and assemblies which comprise the complete equipment; for example: ship service turbo generator: the turbine, reduction gear, generator and exciter.

3.1.7 Installation. - Instructions, if necessary to supplement the installation drawings supplied (in accordance with Specification MIL-D-963), shall consist of methods of installation; including packing or unpacking, handling, preparation of foundation, alignment, precautions, mounting instructions, bolting diagrams, safety guards, grounding or bonding, clearances for access, ventilation, motion under shock, and methods of testing to assure satisfactory installation.

3.1.8 Principles of operation. - Figures, sketches, performance curves, and schematic wiring diagrams shall be included to the extent necessary to provide satisfactory operation, maintenance and repair. Operating sequences of automatic and semi-automatic equipment shall be indicated.

3.1.9 Operating instructions. - Information shall include routine and emergency procedures,

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and safety precautions; maximum and minimum loads; normal temperatures or pressure limits or both; transfer from manual to automatic operation (or the reverse), to be observed in the starting, operating, stopping, and shutting down of the equipment. In addition, action(s) which should be taken in the event of power failure; control air failure; lube-oil failure; partial failure of equipment; and similar conditions shall be described. Action(s) described in the event of partial failure shall include, where practicable, those procedures necessary to provide continued service of the equipment until time is available to repair the equipment. Where operating procedures are to be performed in specific sequence, step-by-step procedures shall be given. Operations shall be numbered in the order in which they are performed. Tables and charts shall be used for the presentation of these instructions where varying operating conditions are encountered.

3.1.10 Maintenance and repair.

3.1.10.1 Preventive maintenance. - Instructions shall include all maintenance procedures, inspections, tests, and adjustments which should be performed periodically under shipboard conditions for the purpose of preventing failure or impairment of the equipment. A one page summary and time schedule for maintenance procedures, including a check-off table where appropriate, shall be provided. The summary sheet shall identify any items required by the Navy, as indicated at time of approval action, to be included in the ship's permanent history cards. Where necessary instructions shall include procedures for obtaining access to the sub-components for maintenance. Maintenance instructions shall include, where appropriate, but shall not be limited to the following:

- (a) A tabulation of periodic, routine, mechanical, and electrical tests and checks which should be accomplished regularly to show that sub-components are operating properly and to insure continuity of service at optimum performance.
- (b) Table or charts, including "wear-limit" charts when appropriate, to indicate what is to be done, when it is to be done based on inspection, and how to do it.
- (c) Utilization of the test facilities which may be incorporated in the various components.
- (d) Instructions for the care, inspection, and cleaning of all pertinent parts.
- (e) Instructions stressing the importance of properly maintaining all safety devices and interlocks provided to prevent damage to equipment or injury to personnel.
- (f) Instructions on lubrication at shipboard operating temperatures shall be pro-

vided as applicable, preferably in chart form. They shall include information regarding lubrication recommended by the manufacturer and the type of lubricant to be used. Lubricants shall be described by symbol number, Federal stock number, Military specification and industry standard numbers where applicable and known.

- (g) Instructions on in-place-balancing or other means of reducing noise level if equipment specifications and shipboard application require quiet operation.

3.1.10.2 Trouble shooting, overhaul and repair. - Instructions shall include all information necessary to permit a technician to locate trouble, and to make repairs, adjustments and conduct tests of each component, assembly or sub-assembly of the equipment. The following shall be included:

- (a) Trouble shooting guides for the localization of faults giving possible sources of trouble, the symptoms, probable cause, and instructions for remedying the faults.
- (b) Complete instructions on signal tracing for electric circuits, use of special test instruments and unusual servicing techniques.
- (c) Ample figures and sectional views giving details of mechanical assemblies, and simplified schematic diagrams of electrical, mechanical, hydraulic and pneumatic circuits. Figures contained elsewhere in the manual may be used and referred to under this heading without duplicating them.

3.1.11 Parts list. - The parts list shall include identification data covering all repair parts to facilitate ready identification of parts for replacement and ordering purposes. Standard hardware, structural parts, or other parts which have no maintenance significance shall not be listed.

3.1.12 Special tools. - A separate list of "special tools" which are supplied with the equipment shall immediately follow the parts tabulation; this list shall contain only tools that are peculiar to the equipment showing the quantity, unit of issue (each, pair, set), description, and manufacturer's identification number. A photograph or sketch showing each special tool as it is being used, shall be included in the manual.

3.1.13 Photographs and drawings. - As the preferred alternate to lengthy, detailed discussions, the manual shall make maximum use of shop photographs, with parts annotated for identification. Photographs may be half-tones or glossy prints. Manuals shall contain reproductions of drawings,

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additional block diagrams and schematic drawings as necessary to supplement the descriptive matter contained in the text. In every case, a drawing or photograph of the assembly shall be included. Diagrams of switches and relays used in the system showing the terminal numbering shall be inserted as additional drawings. Photographs and sketches shall be included wherever necessary for identification of the parts in the "parts list". Other figures shall be included to supplement or extend the information contained in the photographs and drawings as required for further identification of parts and explanation of the descriptive information contained in the text.

### 3.2 Format. -

3.2.1 Volumes. - Manuals shall be divided into volumes and by chapters or sections as necessary to provide ready handling and to present orderly instructions for operation and maintenance of the equipment, depending on the size and complexity of the manual.

3.2.2 Numbering. - Any section, chapter, page and paragraph numbering system which facilitates adequate indexing and rapid location of pertinent information is acceptable.

### 3.3 Text. -

3.3.1 Wording. - The text shall be factual, specific, concise, and clearly worded to be readily understandable by personnel involved in the operation, repair, overhaul and maintenance of the equipment, and to provide sufficient information for technicians to install, operate, service; and maintain the equipment at peak performance without the services of a manufacturer's representative. Technical phraseology requiring a specialized knowledge shall be avoided except where no other wording will convey the intended meaning, in which case the technical term shall be defined.

3.3.2 Level of writing. - As a general guide, the level of writing should be that for a high school graduate having specialized training as a technician through Navy training courses.

3.3.3 Figures. - Sectional views of assemblies, sub-assemblies and the component parts thereof shall be shown as necessary to supplement the text, photographs, and drawings and aid in the identification of parts. Identification of illustrated parts with listed parts shall be facilitated by the use of index (or piece) numbers and arrows which will identify assemblies, sub-assemblies and component parts thereof.

3.3.4 Indexing and referencing of figures. - Significant features or components of figures shall

be identified by brief applicable nomenclature with arrows. Index (or piece) numbers may be used on figures when an extremely large amount of nomenclature is required.

3.3.5 Deleted figures. - When a change requires deletion of a figure without substitution of another, the following sentence shall be inserted "Figure \_\_\_\_\_ deleted" in or near the place of deletion.

3.3.6 Notes, cautions and warnings. - Notes, cautions and warnings should be used to emphasize important and critical instructions. The use should be as sparing as is consistent with real need. When used, notes, cautions and warnings should immediately precede the applicable instructions and shall be selected in accordance with the following definitions:

- (a) "NOTE" - An operating procedure, condition, etc., which it is essential to highlight.
- (b) "CAUTION" - Operating procedures, practices, etc., when if not strictly observed, will result in damage or destruction of equipment.
- (c) "WARNING" - Operating procedures, practices, etc., which will result in personal injury or loss of life if not correctly followed.

### 3.4 Applicability of manuals. -

3.4.1 Identical. - When a class A manual covering a specific equipment or a class B manual which is already available, is applicable in its entirety to the equipment being procured, the applicability is to be extended to include the additional ships by the manufacturer issuing an approval and procurement record page. Copies of the manual required for the ship(s) and local use may be requisitioned from stock by the cognizant Naval supervising activity.

3.4.2 Identical except for minor modifications. - When a class A manual covering a specific equipment or a class B manual is applicable to the equipment being procured except for minor differences, the manufacturer shall modify the manual to cover the differences by the issue of revised or supplementary pages. All revisions to an existing manual shall be approved by the Bureau of Ships, shall require the assignment of a change number, assigned by the Bureau of Ships, and shall be issued by the manufacturer with an approval and procurement record page.

3.5 Revisions. - Revisions to manuals which have been previously distributed shall be prepared as follows:

- (a) New pages - New pages shall be issued when it is found necessary to include new information to augment the content of the original manual.

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- (b) Revised pages - Revised pages shall be issued to make changes which apply uniformly to all equipments covered by the manual.
- (c) Supplementary pages - Supplementary pages shall be issued when necessary to provide alternate instructions applicable only to a portion of the total equipments covered by the manual because of minor modifications or minor differences in related components.

3.5.1 Legend for revisions. - All new, revised or supplementary pages shall include the words "new", "revised" or "supplementary", the date and a change number.

3.5.2 Submission for approval. - Four copies of each revision shall be submitted to the Bureau for approval and assignment of a change number. The forwarding letter shall include the number of stock copies and the estimated delivery date of the final copies.

3.6 Production requirements. - Detail materials, printing procedures and assembly for each manual shall be as approved at time of class A or B manual approval. An acceptable arrangement is set forth in the appendix of this specification. Alternate arrangements will be approved if equivalent performance is provided.

3.7 Distribution requirements. - Unless otherwise specified in the contract or order, distribution of all manuals not exactly identical to one previously procured and assigned a NAVSHIPS number shall be as follows:

- (a) Two copies for each equipment shall be packed with the equipment when the equipment is shipped to stock.
- (b) Two copies for each equipment shall be shipped separately to the cognizant Naval supervising activity marked for each ship on which the equipment is to be installed.
- (c) Two copies to the Bureau of Ships.
- (d) Three copies to the cognizant Supervisor of Shipbuilding when the equipment is to be installed by a private shipyard. (These copies are in addition to the copies for placement on board the ship.)
- (e) Two copies to the Naval shipyard when the equipment is to be installed by that activity. (These copies are in addition to the copies for placement on board the ship.)
- (f) One copy to each U.S. Naval Shipyard except Pearl Harbor and Portsmouth Naval Shipyard (total of nine).

- (g) Two copies to Pearl Harbor Naval Shipyard (for submarine and surface ship equipment).
- (h) Two copies to Portsmouth Naval Shipyard (for submarine equipment only).
- (i) One copy to all active submarine tenders (submarine equipment only).
- (j) One copy to Submarine Bases, New London and Pearl Harbor (submarine equipment only).
- (k) Two copies to Commanding Officer, Ships Parts Control Center, Mechanicsburg, Penn.
- (l) One copy to Naval Supply Centers, Norfolk and Oakland.
- (m) One copy to Naval Supply Depot, Clearfield, Odgen, Utah.
- (n) One copy to Forms and Publications Supply Office, Byron, Georgia.
- (o) Manuals for stock shall be in the following quantities:

<u>Number of equipments</u>	<u>Number of copies</u>
1 to 25	25
26 to 99	50
100 and over	100

These manuals shall be shipped to:  
Receiving Officer, Naval Supply Depot,  
Mechanicsburg, Penn.  
Marked for COG I stock.

- (p) Copies of approval and procurement record pages in accordance with paragraph 3.10.

3.8 Unless otherwise specified in the contract or order, (where manuals are not to be drawn from stock, see 3.4.1) distribution of all manuals exactly identical to ones previously approved shall be as follows:

- (a) Two copies for each equipment shall be packed with the equipment when the equipment is shipped to stock.
- (b) Two copies for each equipment shall be shipped separately to the cognizant Naval supervising activity marked for each ship on which the equipment is to be installed.
- (c) Copies of approval and procurement record pages in accordance with 3.10.

3.9 Revisions. - Revision pages shall be distributed to all activities receiving the original manual, and in the same quantity.

3.10 Approval and procurement record page. - This page shall be included in all copies of the

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manuals and additional copies distributed as follows:

- (a) Two copies to Bureau of Ships.
- (b) One copy to Forms and Publications Supply Office, Byron, Georgia.
- (c) One copy to Ships Parts Control Center, Mechanicsburg, Penn.

**3.11 Military Assistance Program Ships.** - Unless otherwise specified in the contract or order, distribution of all final manuals for ships being constructed, reactivated, converted or otherwise readied for transfer under the Military Assistance Program (MAP) shall be as follows:

- (a) Two copies for each equipment shall be shipped separately to the cognizant Naval supervising activity marked for each ship on which the equipment is to be installed.
- (b) Six copies per equipment for each ship to be transferred under MAP to a foreign government. These copies shall be sent to the Military Assistance Advisory Group (MAAG) of the recipient country for delivery to the foreign government which is to receive the ships.
- (c) One copy to the Washington, D. C. Naval Attache of the foreign government to receive the ships.
- (d) Two copies to the Bureau of Ships.
- (e) One copy to the cognizant Supervisor of Shipbuilding when the equipment is to be installed at a private yard.
- (f) One copy to the Commanding Officer, U. S. Navy Forms and Publication Supply Office, Byron, Georgia.
- (g) Twelve copies to Receiving Officer, U. S. Naval Supply Depot, Mechanicsburg, Penn., marked for COG I stock.

#### 4. QUALITY ASSURANCE PROVISIONS

**4.1 Contractor responsibility.** - The supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the supplier may utilize his own or any other inspection facilities and services acceptable to the Government. Inspection records of the examinations shall be kept complete and available to the Government as specified in the contract or order. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

**4.2 Inspection.** - Sample copies shall be inspected to determine compliance with the requirements of this specification and for equivalence with

the approved (when applicable) sample or basic manual. (If any subsequent issue of manuals is not equivalent to or better than an approved class A manual, class A approval may be withdrawn.)

**4.3 Content.** - The content of the manual shall be checked against the equipment being furnished to assure that it depicts accurately and adequately the equipment and the operating and maintenance procedures required. The NAVSHIPS number on the manual shall be checked for agreement with the NAVSHIPS number on the equipment identification plate where specified.

#### 5. PREPARATION FOR DELIVERY

##### 5.1 Packaging and packing. -

**5.1.1 Individual and multi-volume manuals.** - Individual copies and multi-volume manuals shall be packed to preclude damage to material. Multi-volume manuals shall be furnished as complete sets.

**5.1.2 Manuals shipped with equipment.** - When two copies of the manual are packed with the equipment they shall be packed within the shipping container holding the main unit of equipment. The manual(s) shall be so placed that they are readily accessible prior to removing the equipment and shall not be placed within the vapor proof barrier material used to enclose the equipment. Manuals accompanying equipment shall be packaged in a waterproof container. The invoice packing list or bill of lading shall include the NAVSHIPS number of the manual, the quantity and shall indicate which container includes the manuals.

**5.1.3 Bulk shipment.** - Manuals shipped in bulk shall not be individually wrapped. Containers shall comply with the Uniform Freight Classification Rules or other carrier regulations as applicable to the mode of transportation.

**5.2 Marking.** - On bulk shipments, interior packages and exterior shipping containers shall be marked with the following information for each item enclosed, except for shipment of an individual copy or an individual set of manuals:

Box (number) of (number) (to be listed on multiple container shipments)	
NAVSHIPS number	(manual number)
Quantity	(in package)

The words "FOR STOCK" shall be endorsed on the package or packages destined for stock, unless otherwise specified. NAVSHIPS numbers shall be indicated on the shipping documents. When a contract or order requires manuals having different

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NAVSHIPS manual numbers, the stock copies of each manual number shall be shipped separately.

## 6. NOTES

6.1 Ordering data. - Equipment specifications and procurement documents shall specify the following:

- (a) Title, number and date of this specification.
- (b) Quantity of manuals or APR pages required, delivery date and delivery destinations (see 3.7 through 3.11 inclusive).

6.2 Classes of manuals. - The class of manual need not be specified in equipment specifications or procurement documents. The intent is that the manufacturer shall supply class A manuals for any equipment for which he has received class A manual approval. He shall supply class B manuals wherever he has not been granted class A approval.

6.3 Use of term "Service Manual". - Manuals to this issue of the specification are identified as "Service Manuals", instead of "Technical Manuals" since past use of the word "Technical" tended to denote a comprehensive, expensive, theoretical and engineering document whereas all that is necessary is a document that provides for satisfactory operation, maintenance and repair.

6.4 Elimination of types. - Previous issues of this specification have established different types

for manuals. Types have been eliminated from this issue. The content and make-up of each manual should be tailor-made to delineate the particular operation and maintenance procedures required.

6.5 Rights in data. - Wherever unlimited rights in data are not obtained, the manual should eliminate all proprietary information if operation and maintenance suitability is not thereby reduced. If proprietary information is required to be included and only limited rights in data are obtained, a restrictive clause per ASPR Section 9 should be included on the cover of each manual for ready identification.

Notice. - When Government drawings, specifications or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever, and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying and rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

Preparing activity:  
Navy - Ships  
(Project 7610-N014Sh)

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## APPENDIX

## 10. SCOPE

10.1 This appendix covers the requirements for the production of service manuals.

and symbols shall be of a uniform contrast throughout the documents. Blurred or smudged printing or drop out of characters or lines shall be cause for rejection of the publication. Characters shall be no smaller than 8 point type.

## 20. REQUIREMENTS

20.1 Quality. - All manuals furnished will be subject to 35-mm microfilming. Letters, lines and

20.2 Typography. - Preferred typography is set forth in table I. When revisions are made to the basic manual, the typography shall conform as nearly as possible to the original manual.

Table I - Typography for 8-1/2 by 11 inch manual.

Use	Type style and size	Capitalization	Leading	Spacing between units
Security classification A condensed Chapter or section titles	Gothic 14 pt. *	Capitals	6 pt.	
	Same type as text	Capitals	6 pt.	48 pt. Following marginal copy, text of illustration 18 pt. Preceding text or illustration
Primary side heads	Same type as text	Capitals	2 pt.	6 pt. Preceding or following text
Subordinate side heads	Same type as text	Capitals	1 pt.	6 pt. Preceding or following text
Figure and table titles	Same type as text	Capitals and lower case	2 pt.	6 pt. Following illustration
Notes and cautions	Same type as text	Capitals centered	----	4 pt. Preceding and following text
Warnings	Same type as text	Capitals centered	----	4 pt. Preceding and following text
Text, table of contents, list of illustrations etc.	Book face (roman) bold 10 pt.	Capitals and lower case	1 pt.	12 pt. Preceding illustration or following figure title 6 pt. Preceding or following notes, cautions, warnings
Keys or legends	Book face (roman) italics 8 pt.	Capitals and lower case	1 pt.	6 pt. Preceding figure title or following illustration
Parts breakdown listings	Book face (roman) 8 pt.	Capitals and lower case	1 pt.	12 pt. Preceding text
Footnotes	Book face (roman) bold 8 pt.	Capitals and lower case	1 pt.	6 pt. Preceding bottom rule or following headings

\*If 14 pt. is not available, next smaller size shall be permitted.

## NOTES

1. It is not the intent of this appendix to qualify the methods or composing equipment to be used, but to specify results required.

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## NOTES TO TABLE I (cont'd)

2. Leading and spacing may be relaxed where circumstances require such alterations.
3. The above requirements are for type that will reproduce same size. When oversize pages are used, type shall reduce to approximately these sizes.
4. All type specified may be plus or minus 1 point, except that 8 point type shall be the minimum allowable size.
5. The type faces listed below are the most preferred. They are available in linotype or can be closely matched on office composing machines.

Book face (Roman)

Garamond  
Modern  
Bookman  
Tribune News  
Times Roman  
Antique  
Baskerville  
Century

6. Type sizes as indicated in the requirements were selected for conservation of space and legibility and should not be changed except:

- (a) When oversize pages are prepared.
- (b) When unusual copy fitting problems arise.

20.3 Layout. -

20.3.1 Text pages. - The preferred layout of 8-1/2 inches by 11 inches text pages is two columns 20 picas wide and 54 picas deep, making an overall page image size of 42 by 60 picas. The text and illustration areas shall conserve space without lessening clarity or legibility. Blanks and spaces shall be avoided, except on fold-ins, and the first major division of the manual (chapter or section) shall be a new odd page.

20.3.2 Fold-ins. - Fold-in pages shall be used only for diagrams, drawings or charts which cannot be reduced for satisfactory presentation on a single page, or when frequent reference is required from other pages of the book. Aprons are required. When fold-in pages are used, they should be held to a two-page fold-in whenever practicable and shall not exceed an overall length of 34 inches from the binding edge including the apron. The apron may contain information pertaining to the diagram, drawing or chart.

20.4 Form-punching and drilling. - Service manuals shall be prepared in looseleaf form unless otherwise specified or approved. Looseleaf publications and revisions shall be punched for looseleaf binding with three holes one-fourth inch in diameter and four and one-fourth inches center to center (for 8-1/2 by 11 inch pages) or with such other drilling or punching as specified. Punching of revision pages shall be the same as punching of the original manuals.

20.5 Size. - Suggested sizes for final trim of service manuals follow:

4-3/8 by 6-3/4  
8-1/2 by 11

All dimensions are in inches.

20.6 Paper stock. -

20.6.1 Text pages. - Paper stock for text pages shall be as specified in 20.6.1.1 or 20.6.1.2.

20.6.1.1 Lithography. - Paper stock shall be white offset book free from unbleached or ground woodpulp and shall have a substance weight of not less than 100 pounds per 1,000 sheets, basis 17 by 22 inches.

20.6.1.2 Letterpress. - Paper stock shall be equivalent to white supercalendered book containing not to exceed 5 percent unbleached chemical wood or ground woodpulp, the remainder to be bleached chemical woodpulp, and shall have a substance weight of not less than 90 pounds per 1,000 sheets, basis 25 by 38 inches.

20.6.2 Fold-ins. - Paper stock for fold-in pages shall be equivalent to high wet strength lithographic map, free from unbleached or ground woodpulp, and shall have a substance weight of not less than 48 pounds per 1,000 sheets, basis 17 by 22 inches.

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20.6.3 Binders. - Binders shall be of plastic or pressboard and shall accommodate looseleaf manuals punched or drilled as specified in 20.4 and shall facilitate insertion of replacement pages. Commercial type fasteners are to be used. Information to be

included on the binders shall not be stamped with gold or any other metal foil. Binder colors for unclassified manuals shall be any color except yellow or red. Binders for confidential manuals shall be red. Binders for secret and top secret manuals shall be yellow.

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NAVSHIPS 000-000  
SECURITY CLASSIFICATION

VOLUME I OF III

TITLE OF  
MANUAL  
(U)

GROUP CLASSIFICATION MARKING (for classified manuals. See DD 254)

SECURITY CLASSIFICATION

Figure 1 - Cover.

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NAVSHIPS 000-000  
SECURITY CLASSIFICATION

VOLUME I OF III

# TITLE OF MANUAL (U)

*WARNING: This document contains information affecting the national defense of the United States within the meaning of the Espionage Laws, Title 18, U.S.C., Sections 793 and 794. The transmission or the revelation of its contents in any manner to an unauthorized person is prohibited by law.*

SECURITY CLASSIFICATION

Figure 2 - Title page.

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## APPROVAL AND PROCUREMENT RECORD PAGE

Approval Authority shall include the applicable letters or correspondence granting approval in conformance with approval procedures.

Remarks space shall be used for necessary comments and the inclusion of information regarding the extension of a manual by minor revisions.

Certification: One of the following certification paragraphs shall be typed in this space, as appropriate:

For Class A manuals covering specific equipments.

It is hereby certified that NAVSHIPS \_\_\_\_\_ is identical to the basic manual NAVSHIPS \_\_\_\_\_ approved by the approval data shown above except for the detailed information required for the equipment provided under contract or purchase order \_\_\_\_\_.

For original Class B manuals.

It is hereby certified that NAVSHIPS \_\_\_\_\_ to be provided under contract or purchase order \_\_\_\_\_ has been approved by the approval data shown above.

For identical Class A manuals covering specific equipment and Class B manuals.

It is hereby certified that the manuals to be provided under contract or purchase order \_\_\_\_\_ approved are exactly identical to NAVSHIPS \_\_\_\_\_ approved by authority of approval data shown above.

For Class A manuals covering specific equipment and Class B manuals which have been previously distributed but required minor modification.

It is hereby certified that the manuals to be provided under contract or purchase order \_\_\_\_\_ approved are exactly identical to NAVSHIPS \_\_\_\_\_ approved by the approval data shown above except for the necessary modification as shown in the above remarks space.

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Figure 3 Approval and procurement record page.

## SPECIFICATION ANALYSIS SHEET

## Instructions

This sheet is provided for obtaining information on the use of this specification which will insure that suitable products can be procured with a minimum amount of delay and at the least cost.

Comments and the return of this form will be appreciated.

Fold on dotted lines on reverse side, staple in corner, and send to Bureau of Ships, Specifications and Standardization Branch, Washington 25, D. C.

Specification		
Organization	City	State
Contract No.		
Quantity of Items Procured		Dollar Amount \$
Material procured under a direct Government contract <input type="checkbox"/> or a subcontract <input type="checkbox"/>		
1. Has any part of the specification created problems or required interpretation in procurement? a. Give paragraph number and wording.		
b. Recommendations for correcting the deficiencies.		
2. Comment on any specification requirement considered too rigid.		
3. Is the specification restrictive? <input type="checkbox"/> Yes <input type="checkbox"/> No		If the answer is "Yes", in what way?
4. Remarks (Attach any pertinent data which may be of use in improving this specification.) Place this form and papers in an envelope and send to the Bureau.		
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# Exhibit 28

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## ASBESTOS DUST CONCENTRATIONS IN SHIP REPAIRING: A PRACTICAL APPROACH TO IMPROVING ASBESTOS HYGIENE IN NAVAL DOCKYARDS

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(Received 4 January 1971)

**Abstract**—A survey of the asbestos fibre concentrations associated with work involving asbestos insulating materials has been undertaken in Devonport Dockyard. The results show that application and removal of asbestos materials both create high dust concentrations, and measures to reduce the health hazards associated with such processes are described. The results of sampling after the introduction of preventive measures are briefly presented and these results indicate that the measures are effective in reducing the asbestos dust concentrations in shipyard insulation processes.

There have been few published reports on asbestos dust concentrations occurring in the shipbuilding and shiprepairing industry despite the increasing interest in the health hazards associated with asbestos. The present paper is part of an extensive study of the hazards associated with asbestos in Devonport Dockyard (HARRIES 1970).

### THE USE OF ASBESTOS IN NAVAL DOCKYARDS

Amosite, chrysotile and crocidolite asbestos have been used in insulating materials for Naval ships since about 1880. Large amounts of high efficiency insulants have been required to keep pace with progressive ship design, and airborne asbestos dust has been liberated whenever these materials have been applied or removed. From 1940 to 1963 environmental insulation was applied mainly in the form of asbestos sprayed onto deckheads and bulkheads. Most of the asbestos for this purpose was crocidolite, but some amosite was also used. Pipes and machinery have been insulated with moulded sections containing from 15–90 per cent amosite asbestos. These fragile sections were covered with a protective layer of chrysotile asbestos cloth. During refit periods large amounts of sprayed environmental insulation, and often all machinery insulation were ripped out to facilitate modernisation and repair of the ships. There are many other uses of asbestos, and some of these will be described later.

Because the full extent of the hazard associated with asbestos was not appreciated, adequate preventive measures were not introduced into Naval Dockyards until 1967. Variable amounts of asbestos debris were left scattered about the ships for most of the refit periods (sometimes up to 3 yr), because there was no defined procedure for clearing it away. As a result very large numbers of men have been exposed to asbestos dust by working with or near other men who were applying or removing asbestos

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materials, or because they were themselves disturbing asbestos debris and creating their own local dust clouds.

Energetic measures have now been taken by the Ministry of Defence (Navy) to reduce the hazards associated with asbestos in Naval Dockyards and these have been described by HARRIS (1968, 1970), and by the MINISTRY OF DEFENCE (NAVY) (1970). This report describes the dust concentrations associated with the use of asbestos materials, and the improvements that have been brought about by the recent preventive methods.

## METHODS

### *Dust sampling survey*

Sampling was planned in an attempt to give some idea of dust concentrations likely to have been present in the ships over the last 25 yr. The revision of design specifications, as well as substitution to reduce the dust hazard, made it necessary to take the bulk of these samples in ships containing the old materials in order to give some idea of past conditions. The opportunity to do this occurred in an aircraft carrier and a cruiser in 1967. The samples during other processes, especially the application of insulation, have been taken in destroyers and frigates, as well as in the larger vessels so as to give an idea of present working conditions.

### *Sampling methods*

The membrane filter method of sampling and evaluation described by HOLMES (1965) was used for this survey. Millipore type GA 20 and 25 mm membrane filters, pore size 0.45  $\mu\text{m}$  were used in Gelman sampling heads, and air was drawn through them by using Hunt personal samplers (HUNT and ELLISON, 1963) Austen-Dymax diaphragm pumps, or Dräger hand pumps. The Hunt samplers run at a flow rate of 11.3 ml/min, and the Austen-Dymax pumps at 200 ml/min. Both were calibrated with a suitable Rotameter flow meter. The Hunt samplers were worn by men to give an estimate of personal exposure, or were placed alongside long-running gravimetric samplers to provide an estimate of the fibre content of the dust; sampling lasted over a working shift. Austen-Dymax pumps were used to take shorter samples. A comparison between the results of gravimetric sampling and fibre counting is the subject of a separate report.

Many samples were taken with Dräger hand pumps to obtain 200–2000 ml samples. The disadvantages of small, quick samples are recognised, but it is considered that these are valuable as a method of indicating the fluctuation in the local dust concentrations of various processes. The samples were taken in the general environment as well as in the breathing zone of the workers. Small samples are also useful in showing the change in dust concentrations at varying distances or the rate of change after work has stopped. These methods now form the basis of dust monitoring to be used in Naval Dockyards.

The method of fixing the samples, clearing the membrane and the counting technique has been fully described by HOLMES (1965). The samples were counted under phase contrast microscopy at  $\times 400$  magnification. Fibres were counted 5–100  $\mu\text{m}$  in length with an aspect ratio of 3 : 1 or over.

## Asbestos dust concentrations in ship repairing

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## RESULTS OF SAMPLING

*Sprayed asbestos insulation*

No results for spraying are available from the present study because the process ceased in 1963. Records of dust sampling during spraying in 1951 show asbestos fibre counts of 173 322 fibres/cm<sup>3</sup> (fibres 2-10  $\mu$ m length only) and 3121 5957 particles/cm<sup>3</sup> of other dusts (particles 0.5-5  $\mu$ m dia.). This was obviously a most hazardous operation.

The results shown in Table 1 are the concentrations found during the removal of

TABLE 1. ASBESTOS DUST CONCENTRATIONS DURING REMOVAL OF SPRAYED CROCIDOLITE ASBESTOS

	Sample location				
	Aircraft hangar	Adjacent areas	Small compartments	Adjacent areas	Sweeping and bagging debris
Mean concentration, fibres/cm <sup>3</sup>	334.0	56.5	219.9	82.6	553.0
Range	117-484	19-131	35-384	43-177	215-493
Number of samples	5	4	15	4	2

sprayed crocidolite asbestos from the deckheads and bulkheads of an aircraft carrier. Sampling periods were for 1-2 hr of the working shift as the samples were too dense to count if the sampler was run for the whole shift. Very high concentrations (> 200 fibres/cm<sup>3</sup>) occurred at the stripping areas, slightly lower concentrations (mean > 50 fibres/cm<sup>3</sup>) were recorded for rooms and passageways adjacent to the stripping zone. Sweeping and bagging debris created mean concentrations of 353 fibres/cm<sup>3</sup>, but small samples taken with the Dräger hand pump in the breathing zones of men bagging crocidolite debris showed concentrations of 1000-2000 fibres/cm<sup>3</sup>.

The widespread dispersion of dust throughout the ship is seen from the results in Table 2. Long running samples showed the dust concentration at the top of a ladder running up from the stripping area to the deck above to be 109 fibres/cm<sup>3</sup> and at the top of the next ladder two decks above the stripping area the concentration was

TABLE 2. ASBESTOS DUST CONCENTRATION ASSOCIATED WITH REMOVAL OF SPRAYED CROCIDOLITE ASBESTOS

	Sample location					
	7 Deck stripping area	Hatchway 6 deck leading from 7 deck	Hatchway 5 deck leading from 6 deck	Passageway to shower	Removing suits after shower	Workmen's dining room
Concentration, fibres/cm <sup>3</sup>	311	109	30	25	16	0.05

Long-running Hunt samplers were used.

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30 fibres/cm<sup>3</sup>. This shows the importance of sealing off large parts of the ship when this work is being done and allowing access only to those men wearing adequate respiratory protection.

Special facilities for washing, changing and eating were available on the ship for these men. The results in Table 2 show that although showering when wearing special impervious overalls did not fully remove the fine dust, after the men had removed the contaminated clothing and entered their dining room the dust level they were exposed to were below 0.1 fibre/cm<sup>3</sup>.

#### *Removal of pipe and machinery insulation*

Long running samples were taken with Hunt samplers during the removal of pipe lagging in engine rooms and boiler rooms of aircraft carriers, cruisers and frigates. The materials removed included pipe sections of 90 per cent amosite asbestos, sections of calcium silicate and 15 per cent asbestos, asbestos cloth and cement. Samples were also taken in small compartments, the brick stowage space for example, to show the effect of removing large amounts of insulation in a small confined space. General atmosphere samples were taken at convenient points in the compartment near gravimetric samplers, and breathing zone samples were taken as near as possible to the men's faces. The results in Table 3 show higher mean general sample levels in

TABLE 3. ASBESTOS DUST CONCENTRATIONS DURING REMOVAL OF PIPE AND MACHINERY LAGGING.

Location	General atmosphere			Breathing zone		
	No of samples	Mean, fibres/cm <sup>3</sup>	Range	No of samples	Mean, fibres/cm <sup>3</sup>	Range
Boiler rooms	153	171	0.04-1062	20	91	25-220
Engine rooms	45	88	0.16-3021	25	91	2-490
Brick stowage space	13	257	9-592	..	..	..

boiler rooms (171 fibres/cm<sup>3</sup>) than engine rooms (88 fibres/cm<sup>3</sup>) but similar breathing zone levels in boiler rooms and engine rooms (91-97 fibres/cm<sup>3</sup>). This is because there is more insulating material in a boiler room than in an engine room, and because work proceeds on at least two levels in boiler rooms so that a lot of debris falls 3-4 m to the deck and creates more dust in the general atmosphere. The very high dust levels in the brick stowage space (mean 259 fibres/cm<sup>3</sup>) are the result of a lot of insulation being removed in a small space.

#### *Application of pipe lagging*

Dust concentrations recorded during the application of pipe insulating materials are shown in Table 4. The materials being applied included pipe sections of calcium silicate and 15 per cent asbestos, asbestos rope, asbestos cloth and asbestos cement. The dust concentrations were much lower than for the stripping procedures. As in the stripping operations, and for the same reasons, higher values for general and

## Asbestos dust concentrations in ship repairing

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TABLE 4. ASBESTOS DUST CONCENTRATIONS DURING THE APPLICATION OF PIPE AND MACHINERY LAGGING

Location	General atmosphere			Breathing zone		
	No of samples	Mean, fibres/cm <sup>3</sup>	Range	No of samples	Mean, fibres/cm <sup>3</sup>	Range
Boiler rooms	17	22.4	1-61	14	16.8	0.1-68
Engine rooms	28	2.1	0.1-14	16	7.3	0.04-40
Accumulator room	5	16.5	2.5-46	17	9.6	1-47

breathing zone samples were found in the boiler rooms and the small accumulator room than in the engine rooms.

The results shown in Table 5 indicate that considerable dust concentrations (30-68 fibres/cm<sup>3</sup>) were created by sawing calcium silicate sections, or by removing them from their boxes. Fitting the sections to pipes created high local concentrations (43 fibres/cm<sup>3</sup>), but low general concentrations (4.1 fibres/cm<sup>3</sup>). Clearing calcium silicate debris (134-155 fibres/cm<sup>3</sup>), "blowing down" the debris from inaccessible ledges with an air hose (480 fibres/cm<sup>3</sup>) and sweeping amosite debris (564 fibres/cm<sup>3</sup>) created very high dust concentrations: previously men doing this type of work would not have been protected. Mixing asbestos cement in buckets and removing the dry material from a bag created high general concentrations (167/199 fibres/cm<sup>3</sup>) and even higher breathing zone levels (217-256 fibres/cm<sup>3</sup>).

Wrapping amosite asbestos rope around small bore pipes gave dust concentrations over 100 fibres/cm<sup>3</sup>. Ripping untreated asbestos cloth is a vigorous procedure and produced general dust concentrations of 33 fibres/cm<sup>3</sup> and breathing zone levels of 7 fibres/cm<sup>3</sup>. When the cloth had been contaminated with asbestos debris the mean breathing zone levels in ripping the cloth rose to 20 fibres/cm<sup>3</sup>. Ripping asbestos cloth treated with a dust suppressant by the manufacturers produced dust concentrations which were all less than 1 fibre/cm<sup>3</sup>.

*Removal of asbestos sheets used for acoustic insulation*

This friable material used to soundproof certain compartments of the ship was applied and removed by joiners. The dust concentrations are shown in Table 6. The general atmosphere concentrations were high because the debris was thrown down on to the deck creating intense local dust clouds and the samplers were 1 m above deck level. The mean breathing zone concentrations were lower (130 fibres/cm<sup>3</sup>) since the samplers were carried by the men working up at the deckhead on staging.

*Other processes using asbestos materials*

Relatively low dust levels (mean 2.43 fibres/cm<sup>3</sup>) were seen in sawing perforated asbestos cement sheets (Table 7); these levels were reduced (mean 0.1 fibre/cm<sup>3</sup>) when the sheets were guillotined instead of being cut with a handsaw. Asbestos materials fitted into galley equipment produced mean dust levels of 1.8 fibres/cm<sup>3</sup>, but higher dust levels (mean 20.8 fibres/cm<sup>3</sup>) were found when men fitted calcium silicate slabs into boiler casings. The use of asbestos cloth for maintaining heat in metal to be

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TABLE 5. ASBESTOS DUST CONCENTRATIONS IN MISCELLANEOUS PROCESSES ASSOCIATED WITH PIPE LAGGING

Progress	General atmosphere			Breathing zone		
	No of samples	Mean, fibres/cm <sup>3</sup>	Range	No of samples	Mean, fibres/cm <sup>3</sup>	Range
Sawing calcium silicate sections	7	68	0.7- 158	11	55	7 -152
Removing calcium silicate sections from box	7	30	2 - 78	10	52	16 -136
Fitting calcium silicate section to pipe	9	4.1	0 - 23	20	43	1 -129
Cleaning calcium silicate debris	9	134	32 - 372	7	155	90 -277
Fitting amosite rope	4	118	1 - 280	13	112	5 -340
Removing asbestos 'plastic mix' from container	7	199	48 - 328	13	217	48 -470
Mixing asbestos 'plastic mix' with water in bucket	3	167	53 - 377.4	12	256	24 -799
Ripping cloth (untreated)	2	33	23 - 43	5	7	0.3- 16.5
Ripping cloth (contaminated)	—	—	—	12	20	3.5- 43
Ripping cloth (treated)	12	2.1	0.1	12	2.1	0.1
Stitching cloth	—	—	—	12	3.4	0 - 10
Fitting cloth over lagged pipes	—	—	—	7	22	0.3- 43
"Blowing down" asbestos debris	7	489	140 - 932	—	—	—
Sweeping and bagging amosite debris	10	564	76.3-1191	—	—	—

## Asbestos dust concentrations in ship repairing

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TABLE 6. ASBESTOS DUST CONCENTRATION DURING REMOVAL OF FIBROUS ASBESTOS ACOUSTIC PANELS

No. of samples	General atmosphere		Breathing zone	
	Mean, fibres/cm <sup>3</sup>	Range	Mean, fibres/cm <sup>3</sup>	Range
6	413.5	30-684	131	48-271

welded produced mean dust concentrations of 8.7 fibres/cm<sup>3</sup>. Brushing welding slag off asbestos cloth which had been used to protect equipment during welding and burning was accompanied by mean concentration of 76.6 fibres/cm<sup>3</sup>. Repeated sampling during the pre-heat welding technique when dust suppressed asbestos cloth was used showed counts below 1 fibre/cm<sup>3</sup>.

*Asbestos mattress shop*

A new purpose built mattress shop was erected during the course of the survey and the results in Table 8 show that there is little difference between it and the old shop. The high counts in each shop were associated with sweeping up amosite asbestos fibre around the filling booths.

TABLE 7. ASBESTOS DUST CONCENTRATIONS IN OTHER MISCELLANEOUS PROCESSES

Process	No. of samples	Mean fibres/cm <sup>3</sup>	Range
Sawing and fitting perforated asbestos board	9	2.4	0 - 10
Guillotining perforated asbestos board	8	0.1	0.04- 0.5
Fitting asbestos board in ship's galley	6	1.8	0 - 11
Use of asbestos cloth for pre-heating welding technique	9	8.7	0 - 30
Asbestos cloth used to protect equipment from welding slag	18	76.6	0 - 660
Fitting calcium silicate slabs in boiler casing	18	20.8	1.1 - 7.5

TABLE 8. ASBESTOS DUST CONCENTRATIONS IN ASBESTOS MATTRESS SHOPS

Location	General atmosphere			Breathing zone		
	No of samples	Mean, fibres/cm <sup>3</sup>	Range	No of samples	Mean fibres/cm <sup>3</sup>	Range
Old shop	12	12.7	0-126	15	1.5	0-7
New shop	11	16.3	2- 83	25	3.7	0-17